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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re original Application of:

Applicants	:	Sadeg M. Faris, Gregory J. Hamlin and James P. Flannery
Title of Invention	:	Globally Time-Synchronized Systems, Devices And Methods

Honorable Commissioner for Patents
and Trademarks
Washington, DC 20231

TRANSMITTAL LETTER ACCOMPANYING THE FILING OF AN ORIGINAL APPLICATION

Sir:

This is a request for filing an original application entitled "Globally Time-Synchronized Systems, Devices And Methods," by Sadeg M. Faris, Gregory J. Hamlin and James P. Flannery, and comprising:

- One Hundred Twenty Two (122) pages of Specification;
- Seventy One (71) pages of Claims to Invention;
- One (1) page of Abstract of Disclosure;
- One Hundred One (101) sheets of Drawings; and
- Certificate of Express Mailing (No. EL321109205US) under C.F.R. 1.10 dated February 28, 2000.

Power of attorney has been appointed to Thomas J. Perkowski, Reg. No. 33,134 of Soundview Plaza, 1266 East Main Street, Stamford, Connecticut 06902, and will be filed in the present Application shortly.

The present Application has been assigned to Reveo, Inc. and the assignment will be filed in the present Application shortly.

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Respectfully submitted,

Dated: February 28, 2000

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Attorney Case No. 105-081USA000

GLOBALLY TIME-SYCHRONIZED SYSTEMS, DEVICES AND METHODS

Inventors:
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RELATED CASES

This is a Continuation-in-Part of: Application Serial No. 09/---,--- filed February 25, 2000 entitled "Globally Time-Synchronized Systems, Devices And Methods" by Sadeg M. Faris, Gregory J. Hamlin and James P. Flannery; Application Serial No. 09/258,573 entitled "Internet-Based System And Method For Fairly And Securely Enabling Timed-Constrained Competition Using Globally Time-Synchronized Client Subsystems And Information Servers Having Microsecond Client–Event Resolution", filed February 26, 1999, owned by Assignee, Reveo, Inc., of Elmsford, New York, and incorporated herein by reference as if fully set forth herein.

BACKGROUND OF INVENTION

Field of Invention

The present invention relates generally to improvements in the operation and performance of client-server type internetworked computer systems of global extent, such as the Internet, and more particularly to a novel Internet-based information system and method which enables millions of time-constrained competitions, contests or transactions, among the mass population, in a fundamentally fair and secure manner, using globally time-synchronized client subsystems and information servers having extreme accurate client-event resolution independent of variable network latency.

Brief Description of The State of The Art

While the role of cooperation has a secure place in the history of mankind, so too does the role of competition. Few will disagree that, over the course of

time, human beings have competed in widely diverse ways for both tangible and intangible objects of need and desire. Such objects of need or desire have included: food; shelter; land; rewards; prizes; natural resources; sexual partners; fame; fortune; diversion or recreation, such as sport; and ultimately, survival.

While the nature of man does not appear to have changed fundamentally over the course of time, it is clear that his choice of tools and weapons have changed in step with his increase in technological skill and knowledge.

For example, in the late 1960's, the globally-extensive information infrastructure, now referred to as the Internet, was developed by the United States Government as a tool for national defense and survival in world of intense global competition and military struggle. Ironically, some thirty years later, with the technological development of the HyperText Transport Protocol (HTTP), the HyperText Markup Language (HTML), and the Domain Name System (DNS), a globally-extensive hyper-linked database referred to as the World Wide Web (WWW) has quickly evolved upon the infrastructure of the Internet. By virtue of the WWW, billions and even trillions of information resources, located on millions of computing systems at different locations on Earth, have been linked in complex ways serving the needs and desires of millions of information resource users under the domains .net, .edu, .gov, .org, .com, .mil, etc. of the DNS.

The overnight popularity and success of the WWW can be attributed to the development of GUI-based WWW browser programs which enable virtually any human being to access a particular information resource (e.g. HTML-encoded document) on the WWW by simply entering its Uniform Resource Locator (URL) into the WWW browser and allowing the HTTP to access the document from its hosting WWW information server and transport the document to the WWW browser for display and interaction. The development of massive WWW search engines and directory services has simplified finding needed or desired information resources using GUI-enabled WWW browsers.

Without question, a direct consequence of the WWW, the GUI-based WWW browser, and underlying infrastructure of the Internet (e.g. high-speed IP hubs, routers, and switches) has been to provide human beings with a new set of information-related tools that can be used in ever expanding forms of human collaboration, cooperation, and competition alike.

Over the past several years, a number of WWW-enabled applications have been developed, wherein human beings engage in either a cooperative or competitive activity that is constrained or otherwise conditioned on the variable time. Recent examples of on-line or Web-enabled forms of time-constrained competition include: on-line or Internet-enabled purchase or sale of stock,

commodities or currency by customers located at geographically different locations, under time-varying market conditions; on-line or Internet-enabled auctioning of property involving competitive price bidding among numerous bidders located at geographically different locations; and on-line or Internet-enabled competitions among multiple competitors who are required to answer a question or solve a puzzle or problem under the time constraints of a clock, for a prize and/or an award.

In each of the above Internet-supported applications or processes, there currently exists an inherent unfairness among the competitors due to at least six important factors, namely: (1) the variable latency of (or delay in) data packet transmission over the Internet, dependent on the type of connection each client subsystem has to the Internet infrastructure; (2) the variable latency of data packet transmission over the Internet, dependent on the volume of congestion encountered by the data packets transmitted from a particular client machine; (3) the vulnerability of these applications to security breaches, tampering, and other forms of manipulation by computer and network hackers; (4) the latency of information display device used in client subsystems connected to the Internet; (5) the latency of information input device used in client subsystems connected to the Internet; and (6) the latency of the central processing unit (CPU) used in the client machine.

Regarding the first unfairness factor, it is important to point out that the network latency over the Internet varies over the course of the day and in response to network usage. Expressed differently, the time for a transmitted data packet to travel between a first client computer to a particular information server on the Internet will be different from the time for a transmitted data packet to travel between a second client computer to the same information server on the Internet. This time variance in the network latency on the Internet, referred to as the "variable network latency", must necessarily be modeled a non-deterministic process subject to the laws and principles of random (e.g. stochastic) processes. This has a number of important consequences for Internet-supported forms of time-constrained competition.

For example, in connection with Internet-supported competitions (e.g. games) involving a plurality of competitors or competitors, US Patent No. 5,820,463 attempts to compensate for network latency by measuring the average latency between all the client machines and then inserting intentional communication delays to make the average overall latency the same for all communications links. However, while this system equalizes the communication latency on average, it is wholly incapable of compensating for the random components of network latency (i.e. variable network latency) of the Internet.

Consequently, even when practicing the methods disclosed in US Patent No. 5,820,463, the variable network latency of the Internet nevertheless introduces inherent sources of error into time-constrained competitions, thereby putting certain competitors at an unfair disadvantage, i.e. by virtue of their client computer connection to the Internet in relation to the information server supporting the time-constrained competition.

Regarding the second unfairness factor, it is important to point out that when Internet-supported competition involves a small number of competitors (e.g. 100 or less), the network latency should not be greatly affected by the competitors themselves, but rather will be more dependent on the types of connections the competitor's client machines have with the Internet and on network traffic and congestion as a whole. However, during Internet-supported competition involving massive numbers of competitors, as would exist during Web-based securities and commodities trading, and Web-based auctions, involving thousands or even millions of human beings are all competing simultaneously. Because of the simultaneous start time and the expected distribution of responses, the system will be subject to two intense impulses of traffic, one slightly before the competition start, and the other at the mean response time. It is necessary for the time-constrained competition system to be able to adequately handle this intense bandwidth.

As larger numbers of competitors are becoming involved in a time-constrained competition, it becomes more likely that there will be a tie between two or more competitors. Typically, it is preferable to avoid ties and be able to identify a single competitor as the winner. A time-constrained competition system intended to manage extremely large numbers of competitor must be able to resolve the time of the responses produced by such competitors in order to avoid or reduce the occurrence of ties.

Regarding the third unfairness factor, it is important to point out that each of the above-described time-constrained forms of Internet-supported competition are highly vulnerable to security breaches, tampering, and other forms of intentional network disruption by computer and network hackers. Although the use of a local clock insures fairness, it also raises a potential security problem with the system. Theoretically, an unscrupulous competitor could intercept and modify communications between the client and server, thereby falsifying the time-stamps and gaining an unfair advantage over other competitors. Alternatively, an unscrupulous competitor could modify the local clock, either through software or hardware means, or interfere with the clock synchronization procedure, again gaining an unfair advantage over other competitors. The ordinary encryption/decryption techniques suggested in US

Patent No. 5,820,463 are simply inadequate to prevent cheating or violation of underlying rules of fairness associated with such time-constrained forms of Internet-supported or Internet-enabled competition.

Regarding the fourth unfairness factor, it is important to point out that different types of information display devices have faster refresh rates. In the time-constrained competitions described above, the most common information display device used on client subsystems is the cathode ray tube (CRT) display monitor. In a CRT display monitor, the images presented to the user are drawn by an electron beam onto the screen from top to bottom, one scanline at a time. When the electron beam reaches the bottom, it must then travel back to the top of the monitor in order to prepare to output the first scanline again. The period in which the beam returns to the top of the screen is known as the retrace period. The overall frequency of the screen refreshing and retrace cycle is determined by the frequency of the vertical synchronization pulses in the video signal output by the computer. This frequency is often referred to as the vertical sync rate. In most monitors this rate ranges from 60 to 150 Hz. Unless the vertical redraw time is synchronized with the desired competition "start-time" in time-constrained competition at hand, a random error in the start time is created due to the uncertainty of the actual time the query, bid, price or other information element will be displayed on the display screen of a particular client system used to participate in the time-constrained competition at hand. This "information display latency" error can be as much as ten milliseconds or more depending on the vertical sync rate, and is in addition to any other errors in the start-time caused by network latency, computer processing time, and other factors.

US Patent 5,775,996 addresses the problem of information display latency by providing a method and apparatus for synchronizing the video display refresh cycles on multiple machines connected to an information network. This method involves using methods similar to NTP (network timekeeping protocol) or other clock synchronization algorithms in order to synchronize both the phase and frequency of the vertical refresh cycle on each display. First, the monitors are set to the same frequency using standard video mode setting functions available in the operating system. Next, the phase of the cycle is adjusted by repeatedly switching in and out of "interlaced" mode. Since the interlaced modes have different timings than the standard modes, switching briefly into an interlaced mode will affect the phase of the refresh cycle.

This prior art method has a drawback in that it may be undesirable to modify the refresh rate on a competitor's client machine, since that is in part a personal preference, and typically under the control of the user. All the client

machine video-driver cards may not be physically capable of operating at the same refresh rates, particularly if they are not operating at the same resolution. Also, the monitors themselves may not be capable of operating at a particular refresh rate, and it may be necessary to operate at an undesirable "lowest common denominator" frequency, or not at all. This problem is compounded as more users and client machines are involved.

Another problem with this prior art display synchronization method is that interlaced video modes are not possible on all video driver cards. In addition, switching into interlaced modes may temporarily disrupt the display as the monitor adjusts to handle the new input. Many display monitors will produce an annoying clicking noise as the video mode is changed.

Regarding the fifth "unfairness factor", it must be pointed out that different types of information input devices have faster information input rates. In the time-constrained competitions described above, the most common information input device used on today's client subsystems is the manually-actuated keyboard. In response to manual keystrokes by the competitor at his or her client machine, and electronic scanning operations, the keyboard generates a string of ASCII characters that are provided as input to the client system bus and eventually read by the CPU in the client machine. Only when the desired information string is typed into the client machine, and the keyboard return key depressed, will the keyed-in information string be transmitted to the information server associated with the time-constrained competition. Those with physical handicaps, and those using low-speed information input devices, will have their responses, commands and/or instructions transmitted with greater latency, and therefore arriving at the information server at a later time, assuming all other factors maintained constant for all competitors. In short, depending on the type of input device used, a competitor participating in an Internet-supported time-constrained competition can be put at a serious disadvantage in comparison with those using high-speed information input devices and high-speed processors. When competing against androidal competition (e.g. thinking machines), as currently used in electronic-based securities and commodity trading, and electronic-based auctions, human competitors are placed at a great disadvantage in rapidly changing markets and fast-paced auctions.

Regarding the sixth unfairness factor, it must be pointed out that a further source of latency exists within each client machine due to the fact that the central processor unit (CPU) employed therein: services interrupts posted by competing peripheral devices connected to the client system bus; executes program instructions at a rate set by its clock speed; and has limited memory resources available at any instant in time. These factors operate to further add a

degree of delay in when the data packets associated with the competitor's response is transmitted to the information server supporting the time-constrained competition. Notably, the longer this "processor latency" is, the latter the competitor's response will arrive at the information server supporting the time-constrained competition.

Consequently, the six "unfairness" factors discussed above compromises the integrity any form of time-constrained competition supported on or otherwise enabled over the Internet. Thus must be satisfactorily resolved in order ensure fundamental principles of fairness and fair play that have come to characterize the systems of government, justice, securities, commodities and currency market trading, sportsmanship, and educational testing, in the United States of America and abroad.

Thus there is a great need in the art for an improved way and means of fairly and securely enabling time-constrained competitions for high stakes among millions of competitors scattered around the globe, while avoiding the shortcomings and drawbacks of prior art methodologies including.

OBJECTS AND SUMMARY OF THE INVENTION

Accordingly, a primary object of the present invention is to provide an improved system and method of fairly and securely enabling time-constrained competitions over the Internet while avoiding the shortcomings and drawbacks of prior art methodologies.

A further object of the present invention is to provide a novel system and method of serving and receiving information over the Internet in connection with time-constrained competitive processes so that principles of fairness and fair play which have come to characterize the systems of government, justice, securities, commodities and currency market trading, sportsmanship, and educational testing, in the United States of America and countries abroad, are secured in an economically feasible manner for the betterment of human society.

A further object of the present invention is to provide a novel system and method of serving and receiving information over the Internet in connection with time-constrained competitive processes, which avoids the problems of network latency, ensures microsecond "start-time" accuracy, and can determine winners in the competition within microsecond "finish-time" accuracy.

Another object of the present invention is to provide an Internet-based system for enabling time-constrained competition among a massive number of

competitors while compensating for the variable network communication latencies experienced by client machines used by the competitors.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein a simultaneous start-time is produced for each and every competitor involved in a particular competition regulated by the system.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions using Internet information servers to synchronize the initial display of an invitation to respond (e.g. stock offer, query or problem) on a client machine by shifting the phase of the display refresh cycle.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein the time delay between a displayed invitation to respond (e.g. stock price, bid offer, or query) and the transmitted response is precisely measured using the Pentium™ instruction counter in the client machine.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein client-event timing accuracy is markedly improved by using a globally-synchronized hardware timing device at each client machine to time-stamp each competitor's response to an invitation to respond (ITR) displayed on the display screen of the client machine.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein each client machine deployed therein is protected against intentional tampering through any means by the competitor using the client machine, or by any third party desiring to gain an unfair advantage over other competitors.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, which employs a digital signature method to protect against intentional tampering through any means by a competitor or third party, either intended to disrupt the operation of the competition and otherwise interfere with the enjoyment of other competitors or spectators.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein the digital signature method employs a secret key, stored within a global synchronization unit (GSU) in each client machine, in order to

create the signature for both time-space stamping and to a hash value generated from the data.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein the digital signature can be used to prove that the data (i.e. time-space stamp plus a hash of input data) has not been altered, and to prove that it originated from the holder of the secret key (located within the GSU).

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein each client machine employs a GSU, which combines GPS and digital data signature technology to provide a secure and verifiable time-space stamp on each client machine response.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, which is scalable or extensible and capable of simultaneously supporting a multiplicity of competitions, each involving a virtually unlimited number (e.g. millions) of competitors.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, which protects against clock device tampering at each client machine by utilizing and comparing multiple clock systems employed in each client machine.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein each client machine in the system is provided with a client-based hardware extension to improve clock accuracy and precision and therefore improve client- event response characteristics at each such client machine.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein each client machine in the system is provided with a client-based hardware extension to improve security by means of hardware encryption and decryption.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein varying degrees of simultaneity can be offered, insuring that the start time on all client machines is simultaneous within tens of milliseconds at the least precise level, to on the order of within a few microseconds when all of the measures provided for are used.

Another object of the present invention is to provide an Internet-based system for fairly and securely enabling time-constrained competitions over the Internet, wherein one or more a globally-time synchronized Internet-based information servers simultaneously and securely communicate with millions of globally-time synchronized client machines engaged in a predetermined competition supported over the Internet.

Another object of the present invention is to provide an Internet-based method for fairly and securely enabling time-constrained competitions over the Internet, wherein one or more a globally-time synchronized Internet-based information servers simultaneously and securely communicate with millions of globally-time synchronized client machines engaged in a predetermined competition supported over the Internet.

Another object of the present invention to provide an Internet-based system, wherein each client machine is provided with a hardware device which can precisely time and space stamp an event, and thus securely generate an event only when specific time and space criteria are satisfied, and also verify the authenticity of previously generated time and space stamps produced by the hardware device.

Another object of the present invention is to provide a novel method of time-space stamping which can be used to authenticate electronic-commerce transactions between a vendor, bank and customer with microsecond time accuracy.

Another object of the present invention is to provide a novel system and method for electronically filing legal documents, such as patent applications, property transfer documents and court/litigation documents, with governmental or judicial institutions using the http, file transfer protocols (ftp), electronic data interchange (EDI) techniques, and/or any other file transmission protocols supported over the Internet.

Another object of the present invention is to provide a novel global time-synchronization unit for connection to or embedding within any client machine that is to be used in connection with the Internet-supported system and method of the present invention.

Another object of the present invention is to provide a novel global time-synchronization unit for connection to or embedding within any Internet information server that is to be used in connection with the Internet-supported system and method of the present invention.

Another object of the present invention is to provide an improved system and method of receiving information from securities (e.g. stocks and bonds), commodities and/or foreign currency information servers, representing real-

time or "live" market conditions, and simultaneously disseminating such information to globally-synchronized client machines located world-wide to enable secure "on-line" electronic-based securities trading operations, commodities trading operations, and foreign currency trading operations in a fundamentally fair manner.

Another object of the present invention is to provide an improved system and method for electronic-based on-line securities trading, commodities trading, and foreign currency trading in a secure and fundamentally fair manner using client machines globally-synchronized with corresponding Internet-based securities trading servers, commodities trading servers, and foreign currency trading servers, respectively, so that each market competitor is informed about incremental changes in market conditions at substantially the same time and therefore is permitted to respond to such market condition changes (e.g. changes in stock, commodity or currency prices) at substantially the same time in accordance with principles of fundamental fairness and fair play.

Another object of the present invention is to provide an improved system and method of simultaneously disseminating securities, commodities, and/or foreign currency information (e.g. real-time price quotes) using globally time-synchronized information servers and client machines.

Another object of the present invention is to provide an Internet-based system and method which enables competitors to trade securities, commodities and/or foreign currencies using real-time pricing information that is disseminated to all competitors of a given level of service at substantially the same instant in time using a network of globally time-synchronized information servers and client machines.

Another object of the present invention is to provide an Internet-based information network, wherein competition supporting information servers (e.g. market price advertising servers and order execution servers) are time-synchronized with a plurality of globally-distributed time-synchronized client machines that can be preprogrammed so respond to real-time securities prices within micro-second client event accuracy by transmitting time and space stamped orders to purchase and/or sell securities, commodities and/or foreign currencies.

Another object of the present invention is to provide an Internet-based information network comprising server and client computer systems, wherebetween competition-promoting/supporting processes (e.g. bidding processes) are carried out among individuals over the Internet, and accurate time-stamping operations are performed at both the client and server ends of the network so that the response (i.e. bid) of each individual can be reliably

accepted based upon its submission-time at the client computer system, and not upon the receipt-time thereof at the server computer system.

Another object of the present invention is to provide an Internet-based method of supporting competitive processes over the Internet using a network of server and client computer systems, wherebetween competition-promoting/supporting processes (e.g. bidding processes) are carried out among individuals over the Internet, wherein accurate time-stamping is performed at both the client and server ends of the competition-supporting process, so that the response (i.e. bid) can be reliably accepted based upon its submission-time at the client computer system, and not upon the receipt-time thereof at the server computer system.

Another object of the present invention is to provide a novel method of and system for tracking animate and inanimate objects through the space-time continuum.

Another object of the present invention is to provide such a system, wherein objects to be tracked carry or support wireless GSU-enabled client network devices, of various form factors, which transmit digitally-signed data packets to TS-stamping based tracking servers for decryption, and object tracking and monitoring operations.

Another object of the present invention is to provide an Internet-based system and method of reliably tracking the space-time trajectory of mobile objects using globally time-synchronized clocks, global positioning subsystems, and digital signature techniques carried out with hardware chips embedded within miniature wireless network devices carried by the objects being tracked.

Another object of the present invention is to provide such system and method, where time-space (TS) coordinate data is stored aboard the device as it is generated and then periodically downloaded to the TS-stamping based tracking server, eliminating the amount of time that the client network device has to be on-line.

Another object of the present invention is to provide a wireless GSU-enabled client network device which has one or more biophysiological sensors, to enable remote monitoring of the vital signs of a living object being tracked.

Another object of the present invention is to provide a GSU-enabled client network device having input sensors and input devices selected from the group consisting of: temperature sensors, humidity sensors, light level sensors, chemical sensors, and other physical property sensors, CCD image capturing devices, sound sensing/pickup and recording devices,

fingerprint sensing/detection devices and other biometric sensing devices, vibration sensors, radiation sensors, gas/vapor sensors, speech recognition devices, keypad input devices, graphics input devices, devices for detecting tampering of the GSU-enabled device and/or removal of the GSU from its associated object, and the like.

Another object of the present invention is to provide a novel Internet-based method of and system for securing a region of physical space, wherein a GSU-enabled client network device is provided with a CCD-based digital video camera or scanner for capturing images of a field of view of the camera or scanner, as well as an sound recording device for recording sound within and about the field of view of the camera, wherein each captured image frame is accurately space-time stamped, and recorded on videotape or other digital recording medium.

Another object of the present invention is to provide a novel Internet-based method of and system for securing a computers communications network by embodying a GSU chip of the present invention into each network computing device so that its access to a particular communications/computer network (i.e. subnetwork) or WWW site can be securely enabled a TS-stamping tracking server only upon the generation of a unique time-space stamp by GSU-chip, achieved when the GSU-enabled network computing device is physically present at a predetermined location over a particular time interval.

Another object of the present invention is to provide such an Internet-based method of and system for securing a computers communications network by embodying a GSU chip, wherein a GSU-enabled network computing device which is used to access a particular communications (sub)network or WWW site, is partially enabled by the enabled the TS-stamping tracking server when the GSU-enabled network computing device is present outside of the predetermined location, or predetermined time interval, so that the TS-stamping tracking server can track to the exact location of the GSU-enabled computing device and authorities apprehend the personal using the same without authorization.

Another object of the present invention is to provide a novel Internet-based method and system for enabling "location-and time" based decryption of messages by using a GSU-enabled client computing device of the present invention which is enabled by a TS-stamping tracking server to decrypt certain messages stored on a computer network only at certain times/places (i.e. ranges of TS coordinate data), and at no others, for reasons that need only be known to the author of such messages.

Another object of the present invention is to provide a novel Internet-based method and system for enabling the embedding of a message within a transportable GSU-enabled computing device so that the message can only be decrypted in a specific location at a specific time period.

Another object of the present invention is to provide a novel Internet-based method of and system for enabling the reception of secure radio communications by using a GSU-enabled client computing device of the present invention equipped, with radio communications capabilities, which is enabled by a TS-stamping based tracking receiver to only decrypt an particular incoming radio message or messages at a particular location at a particular period of time, and at no other space-time instant.

Another object of the present invention is to provide a novel Internet-based method of and system for displaying information clues or instructions at particular instances along the space-time continuum, wherein a wireless GSU-enabled client network device (realized for example in the form of a watch or other portable casing having an integrated display screen and keypad) cooperates with a TS-stamping based tracking server through a global communication network so as to enable the GSU-enabled client network device to display information clues and/or instructions only when the GSU-enabled device is present within specific location over a particular time interval (i.e. intersects a prespecified region along the space-time continuum.

Another object of the present invention is to provide a novel Internet-based method of and system for collecting space-time coordinates of an athlete or animal at particular instances along the space-time continuum, wherein a wireless GSU-enabled client network device affixed (i.e. strapped) to the body of a human athlete (e.g. skier, runner or swimmer) or animal participating in sports competition, cooperates with a TS-stamping based tracking server through a global communication network so as to enable the GSU-enabled client network device to collect TS coordinate data during the competition, TD data is collected from the GSU-enabled device carried by the athlete on a real-time basis as the athlete or animal travels from point to point, along a predetermined course, and where collected TS data can be remotely analyzed to determine the performance of the athlete in the competition and determination of a winner.

Another object of the present invention is to provide a novel Internet-based method of and system for enabling the operation of set-top

cable television boxes, and other digital media content delivery devices, in compliance with license agreements, wherein a GSU-enabled network computing device is embedded within each set-top cable television box, and other digital media content delivery device, in a media content delivery system, and one or more TS-stamping based tracking servers are used to track and control such media content delivery devices so that the media content delivery devices are enabled into operation only when such devices are in fact used in accordance with the conditions of use set forth in the license agreement with the customer (i.e. when used within the particular location specified in the license agreement and during the time duration thereof).

Another object of the present invention is to provide a novel Internet-based method of and system for enabling/controlling the operation any portable host system or device which is restricted to operate within a set of space-time constraints, by embedding a GSU-enabled device within each such portable host system or device, and using one or more TS-stamping based tracking servers to track and enable the operation of each such portable host system or device only when such systems and devices are in fact used in accordance with the conditions of use set forth in the license agreement.

Another object of the present invention is to provide a novel Internet-based method of and system for enabling/controlling the operation any portable host system, by embedding a GSU-enabled device within each such portable host system or device, and using one or more TS-stamping based tracking servers to track and enable or otherwise control particular functions within the host system based on its time-space coordinates.

These and other objects of the present invention will become apparent hereinafter and in the Claims to Invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to more fully appreciate the objects of the present invention, the detailed description of the illustrated embodiments should be read in conjunction with the accompanied figures and drawings:

FIG. 1 is a schematic representation of a generalized embodiment of the Internet-based system of the present invention, showing the major physical components thereof comprising a primary server 100 with an embedded GPS

(global positioning system) receiver 170, one or more web servers 110, a login server 120, a competitor database 30, an invitation to respond/response database 40, one or more competition-promoting servers 50 with embedded GPS receivers 170, and one or more client machines 160 with embedded Global Synchronization Units (GSU) 175, all components being interconnected with a globally-extensive network (e.g. the Internet) 190;

FIG. 2 is a schematic representation of a contest-based embodiment of the system of the present invention, showing the major physical components thereof comprising a primary server 100 with embedded GPS (global positioning system) receiver 170, one or more web servers 110, a login server 120, a contestant database 130, an query/answer database 140, one or more game servers 150 with embedded GPS receivers 170, and one or more client machines 160 with embedded Global Synchronization Units (GSU) 175, all components being interconnected with a network 190;

FIG. 2A is a schematic representation of the components directly involved in the query/response portion of the contest supported by the system of FIG. 2, showing the virtual network connections between the primary server 100 and a set of game servers 150, as well as between each game server and an associated set of client machines 160;

FIG. 2B is a schematic representation of the components used to distribute and present the HTML and associated web content to contestants using the system of FIG. 2, showing a plurality of mirrored web servers 110 each connected to a contestant database 130 and each serving a set of client machines 160, and each client machine being equipped with a web browser 320;

FIG. 2C is a schematic representation of the connectivity between the login server 120 and the client machines 160, wherein each client machine is provided with a contest client 340, and the login server is connected to the contestant database 130;

FIG. 2D is a schematic representation of some of the major components of a client machine 160 employed in the system of the present invention, shown comprising a global positioning subsystem 170 and various hardware and software layers, including client software such as a web browser 320, contest client application 340, contest plug-in 330, and contest hooks and drivers 350

FIG. 2D1 is a schematic representation of a client machine 160 equipped with a GSU 175 and connected through the Internet to a server equipped with a GPS clock unit 170;

FIG. 2D2 is a schematic representation of a basic global synchronization unit (GSU) 175 employed in the system of the present invention, shown comprising a GPS antenna 730, GPS receiver 700, central processor 750, host

computer interface 720, GPS disciplined high-frequency clock 710, encryption and decryption module 740, and non-volatile memory 760;

FIG. 2D3 is a schematic representation of some of the major components of a client machine 160 employed in the system of the present invention, shown comprising a global synchronization unit 175 and various hardware and software layers, including client software such as a contest client application 340, contest plug-in 330, and contest hooks and drivers 350;

FIG. 2D4 is a schematic representation of a client machine 160 equipped with an enhanced GSU 177 and connected through the Internet to a server equipped with a GPS clock unit 170, where input and output devices are connected to the client machine 160 through the enhanced GSU 177;

FIG. 2D5 is a schematic representation of an enhanced global synchronization unit (GSU) 177 employed in the system of the present invention, shown comprising a GPS antenna 730, GPS receiver 700, central processor 750, host computer interface 720, GPS disciplined high-frequency clock 710, encryption and decryption module 740, non-volatile memory 760, input device monitor and passthrough module 770, and an output passthrough and signal generation module 780;

FIG. 2E is a schematic representation of some of the major components of a game server employed in the system of the present invention, shown comprising various hardware and software layers including a game server daemon 270 and GPS receiver 170;

FIG. 2F is a schematic representation of some of the major components of a web server 110 employed in the system of the present invention, including web server software 360 providing support for HTML, Java, and other standard protocols and web technologies;

FIG. 2G is a schematic representation of some of the major components of the primary server 100 employed in the system of the present invention, including the primary server daemon 250, a contest management interface 260, a high precision clock or timer 200, high performance network interface 210, and a GPS receiver 170;

FIG. 2H is a schematic representation of some of the major components of the login server 120 employed in the system of the present invention, including the login server daemon 370 and a high performance network interface 210;

FIG. 3A is a schematic representation of the flow of data and messages between a web server 110 and a client machine 160 employed in the system of the present invention, wherein the data flow includes web site content transmitted from the web server to the client machine, encrypted registration information posted to the web server from the client machine, preliminary

contestant username and password sent to the client machine, and contest software downloaded from the web server to the client machine;

FIG. 3B is a schematic representation of the flow of data and messages between the primary server 100 and the login server 120 employed in the system of the present invention, wherein the data flow includes a list of game servers sent from the primary server to the login server;

FIG. 3C is a schematic representation of the flow of data and messages between a game server 150 and the login server 120 employed in the system of the present invention, wherein the data flow includes a request for game server status by the login server, and the request includes the login server's public key for encryption, and wherein the data flow also includes an encrypted reply by the game server to the login server containing status and loading information about the game server, as well as the game server's public key for encryption use by the login server and client machine, wherein the data flow also includes an encrypted contestant login request from the login server to the game server and a corresponding encrypted reply from the game server to the login server containing a game server access code;

FIG. 3D is a schematic representation of the flow of data and messages between the login server 120 and a client machine 160, this data includes an encrypted contestant login request from the client machine to the login server, a message containing an encrypted contestant id sent from the login server to the client machine, and an encrypted message from the login server to the client machine containing a game server address and associated game server access code;

FIG. 3E is a schematic representation of the flow of data and messages between a game server 150 and a client machine 160, wherein the data flow includes a message from the client machine to the game server containing a contestant ID, a game server access code, and a client machine public key, an additional message from the game server to the client machine containing the game server public key, an additional message from the game server to the client machine containing and encrypted query and start-time, a further message from the game server to the client machine containing an encrypted query decryption key, a further message from the client machine to the game server containing a response notification hash, a further message from the client machine to the game server containing the encrypted response data and security verification hash, a further message from the game server to the client machine containing the security log request, a further message from the client machine to the game server containing the encrypted security log, a final message from the game server to the client machine containing the contest results;

FIG. 3F is a schematic representation of the flow of data and messages between the primary server 100 and a game server 150, wherein the data flow includes a message from the game server to the primary server containing the game server public key, an additional message from the primary server to the game server containing the primary server public key, a further encrypted message from the primary server to the game server containing the encrypted query, encrypted start-time, and encrypted answer, a further message from the game server to the primary server containing the encrypted preliminary results for the contest, a further message from the primary server to the game server containing an encrypted security analysis request, a further message from the game server to the primary server contains the encrypted security analysis results, a final message from the primary server to the game server containing the encrypted contest results;

FIG. 3G is a schematic representation of the flow of data and messages between the primary server 100 and a web server 110, wherein the data flow includes game announcements delivered via ftp from the primary server to the web (http) server, and additional data delivered via ftp from the primary server to the web server includes contest results and contestant standings;

FIG. 4 is a flowchart of the high level operations performed by the contest-based system of FIG. 2 so as to enable a contestant to participate in a simultaneous, secure, multi-player time-constrained contest;

FIG. 4A is a flowchart describing in greater detail a method for registering and downloading contest software in the system of FIG. 2;

FIG. 4B is a flowchart describing in greater detail a method for the contestant to log on to the game server of FIG. 2;

FIG. 4C is a flowchart describing in greater detail a method for downloading an encrypted query and start-time to the client machine 160;

FIG. 4D1 is a flowchart describing in greater detail a method for characterizing the client machine local clock 290 and synchronizing the client machine display update cycle in connection with a system of the present invention incorporating a basic GSU 175 in the client machine 160;

FIG. 4D2 is a flowchart describing in greater detail a method for characterizing the client machine local clock 290 and synchronizing the client machine display update cycle in connection with a system incorporating an enhanced GSU 175 in the client machine 160;

FIG. 4D3 is a flowchart describing in greater detail in which a method for characterizing the client machine local clock 290 and synchronizing the client machine display update cycle in connection with a system that does not include a global synchronization unit;

FIG. 4E1 is a flowchart describing in greater detail a method for presenting the query to the contestant at the contest start-time in connection with a system incorporating a basic GSU 175 in the client machine 160;

FIG. 4E2 is a flowchart describing in greater detail a method for presenting the query to the contestant at the contest start-time in connection with a system incorporating an enhanced GSU 175 in the client machine 160;

FIG. 4E3 is a flowchart describing in greater detail a method for presenting the query to the contestant at the contest start-time in connection with a system that does not include a global synchronization unit;

FIG. 4F1 is a flowchart describing in greater detail a method for the contestant to submit a time-stamped response to the previously presented query in connection with a system incorporating a basic GSU 175 in the client machine 160;

FIG. 4F2 is a flowchart describing in greater detail a method for the contestant to submit a time-stamped response to the previously presented query in connection with a system incorporating an enhanced GSU 175 in the client machine 160;

FIG. 4F3 is a flowchart describing in greater detail a method for the contestant to submit a time-stamped response to the previously presented query is outlined for a system that does not include a global synchronization unit;

FIG. 4G is a flowchart describing in greater detail a method for fairly judging the contest and determining the winners of that contest is outlined;

FIG. 5 is a schematic representation of a financial trading-based embodiment of the system of the present invention, showing the major physical components thereof comprising a primary server 100 equipped with GPS (global positioning system) receiver 170, one or more web servers 110, a login server 120, a trader database 35, a real-time market state server 45, one or more real-time price-quotation and trading (Q & T) servers 55, as well as between each RTPQ&T server and an associated set of client machines 160;

FIG. 5B is a schematic representation illustrating the connectivity between the login server 120 and the client machines 160, wherein each client machine is provided with trading client software 345, and wherein the login server is also connected to the trader database 35;

FIG. 6 is a schematic representation of an auction-based embodiment of the system of the present invention (i.e. auction-supporting system), showing the major physical components thereof comprising a primary server 100' with embedded GPS (global positioning system) receiver 170, one or more web servers 110, a login server 120', a bidder database 130', an auction database 140', one or more auction servers 150' with embedded GPS receivers 170, and

one or more client machines 160 with embedded Global Synchronization Units (GSU) 175, all components being interconnected with a network 190;

FIG. 6A is a schematic representation of the components directly involved in the bid/counter-bid portion of the auction supported by the system of FIG. 6, showing the virtual network connections between the primary server 100' and a set of auction servers 150', as well as between each auction server and an associated set of client machines 160;

FIG. 6B is a schematic representation of the components used to distribute and present the HTML and associated web content to contestants using the system of FIG. 2, showing a plurality of mirrored web servers 110 each connected to a contestant database 130 and each serving a set of client machines 160, and each client machine being equipped with a web browser 320;

FIG. 6C is a schematic representation of the connectivity between the login server 120' and the client machines 160, wherein each client machine is provided with a bidding client 340, and the login server is connected to the bidder database 130';

FIG. 6D is a schematic representation of some of the major components of a client machine 160 employed in the system of the present invention, shown comprising a global synchronization unit 175 and various hardware and software layers, including client software such as an auction client application 340', auction plug-in 330', and auction hooks and drivers 350';

FIG. 6E is a schematic representation of some of the major components of an auction server employed in the system of the present invention, shown comprising various hardware and software layers including an auction server daemon 270' and GPS receiver 170;

FIG. 6F is a schematic representation of some of the major components of a web server 110 employed in the system of the present invention, including web server software 360 providing support for HTML, Java, and other standard protocols and web technologies;

FIG. 6G is a schematic representation of some of the major components of the primary server 100' employed in the system of Fig. 6, including the primary server daemon 250, an auction management interface 260', a high precision clock or timer 200, high performance network interface 210, and a GPS receiver 170;

FIG. 6H is a schematic representation of some of the major components of the login server 120' employed in the system of Fig. 6, including the login server daemon 370 and a high performance network interface 210;

FIG. 7A is a schematic representation of the flow of data and messages between a web server 110 and a client machine 160 employed in the system of

Fig. 6, wherein the data flow includes web site content transmitted from the web server to the client machine, encrypted registration information posted to the web server from the client machine, preliminary bidder username and password sent to the client machine, and auction software downloaded from the web server to the client machine;

FIG. 7B is a schematic representation of the flow of data and messages between the primary server 100 and the login server 120' employed in the system of Fig. 6, wherein the data flow includes a list of auction servers sent from the primary server to the login server;

FIG. 7C is a schematic representation of the flow of data and messages between an auction server 150' and the login server 120' employed in the system of Fig. 6, wherein the data flow includes a request for auction server status by the login server, and the request includes the login server's public key for encryption, and wherein the data flow also includes an encrypted reply by the auction server to the login server containing status and loading information about the auction server, as well as the auction server's public key for encryption use by the login server and client machine, wherein the data flow also includes an encrypted bidder login request from the login server to the auction server and a corresponding encrypted reply from the auction server to the login server containing a auction server access code;

FIG. 7D is a schematic representation of the flow of data and messages between the login server 120' and a client machine 160, this data includes an encrypted bidder login request from the client machine to the login server, a message containing an encrypted bidder identification sent from the login server to the client machine, and an encrypted message from the login server to the client machine containing an auction server address and associated auction server access code;

FIG. 7E is a schematic representation of the flow of data and messages between an auction server 150' and a client machine 160, wherein the data flow includes a message from the client machine to the auction server containing a bidder ID, an auction server access code, and a client machine public key, an additional message from the auction server to the client machine containing the auction server public key, an additional message from the auction server to the client machine containing and encrypted minimum and start-time, a further message from the auction server to the client machine containing an encrypted bid decryption key, a further message from the client machine to the auction server containing a response notification hash, a further message from the client machine to the auction server containing the encrypted response data and security verification hash, a further message from the auction server to the client

machine containing the security log request, a further message from the client machine to the auction server containing the encrypted security log, a final message from the auction server to the client machine containing the auction results;

FIG. 7F is a schematic representation of the flow of data and messages between the primary server 100' and an auction server 150', wherein the data flow includes a message from the auction server to the primary server containing the auction server public key, an additional message from the primary server to the auction server containing the primary server public key, a further encrypted message from the primary server to the auction server containing the encrypted auction, encrypted start-time, and encrypted answer, a further message from the auction server to the primary server containing the encrypted preliminary results for the contest, a further message from the primary server to the auction server containing an encrypted security analysis request, a further message from the game server to the primary server contains the encrypted security analysis results, a final message from the primary server to the auction server containing the encrypted auction results;

FIG. 7G is a schematic representation of the flow of data and messages between the primary server 100' and a web server 110, wherein the data flow includes auction announcements delivered via ftp from the primary server to the web (http) server, and additional data delivered via ftp from the primary server to the web server includes auction results and bidder standings;

FIG. 8A is a schematic representation describing the data fields of the Login Information Structure maintained within the log-in server of the system of Fig. 6;

FIG. 8B is a schematic representation describing the data fields of the Auction Information Structure maintained within the auction server of the system of Fig. 6;

FIG. 8C is a schematic representation describing the data fields of the Bid Information Structure maintained within the auction database in the system of Fig. 6;

Fig. 9 is a flowchart of the high level operations performed by the auction-based system of FIG. 6 so as to enable a bidder to participate in a simultaneous, secure, multi-player time-constrained auction;

FIG. 9A is a flowchart describing in greater detail a method for registering and downloading auction software in the system of FIG. 6;

FIGS. 9B1 and 9B2, taken together, is a flowchart describing in greater detail a method for the bidder to log on to the auction server of FIG. 6;

FIGS. 9C1 and 9C2, taken together, is a flowchart describing in greater detail a method for downloading an encrypted auction information and start-time to the client machine 160;

FIG. 9D is a flowchart describing in greater detail in which a method for characterizing the client machine local clock 290 and synchronizing the client machine display update cycle in connection with a system that does not include a global synchronization unit (GSU);

FIGS. 9E1 and 9E2, taken together, is a flowchart describing in greater detail a method for presenting the auction information to the bidder at the auction start-time in connection with a system incorporating an enhanced GSU 175 in the client machine 160, and also a method for the bidder to submit a time-stamped response to the previously presented auction information in connection with a system incorporating an enhanced GSU 175 in the client machine 160;

FIG. 10 is a schematic representation of a modified embodiment of the Internet-based contest-promoting system of the present invention, wherein one or more remote administration consoles 600, contest database 660, and a remote administration server 610 are provided for remotely creating and administering contests over the Internet;

FIG. 10A is a schematic representation of the components shown in FIG. 10 directly involved in the remote administration of contests, showing the virtual network connections between the primary server 100 and a remote administration server 610, between the remote administration server 610 and a contest database 660, contestant database 130, and query answer database 140, as well as between the remote administration server 610 and one or more remote administration consoles 600;

FIG. 10B is a schematic representation of some of the major components of a remote administration console 600 employed in the system of FIG. 10, showing various hardware and software layers, including the administration software being comprised of a remote administration client application 650 and a remote administration plug-in 640;

FIG. 10C is a schematic representation of some of the major components of a remote administration server 610 employed in the system of FIG. 10, showing various hardware and software layers, including the remote administration web server 620 and the remote administration daemon 630;

FIG. 11 is a schematic representation of a subsystem for providing the competition-promoting systems of the present invention with a television-based spectator interface, showing comprising a web server 110, a video-enabled client machine 900, a web-to-video processor 910, taped video content playback unit

960, live video source (e.g. camera) 950, a real-time video compositor 920, broadcasting equipment 930, and television viewers 940;

FIG. 11A is a schematic representation showing an exemplary layout for displaying contest live video, contestant images, and live contest queries, results, scores and statistics on a television-based spectator interface;

FIG. 12 is a schematic representation showing the basic components of a television-based client machine according to the present invention, shown comprising a set-top client machine 970 connected to the user's television set 990 using a standard NTSC or PAL cable, and a remote-control input device 980 for controlling the client machine;

FIG. 12A is a schematic representation showing the major components of the set-top client machine 970 of FIG. 12, shown comprising a GPS receiver 170, clock and timer hardware 290, a television tuner with Intercast™ decoding capability 977, a modem 976, an infrared input port 975, NTSC or PAL audio/video output 974, embedded device drivers 973 and embedded operating system with Java capability 972 running on a microprocessor, and a firmware contest client 971;

FIG. 13 is a schematic representation showing examples of input devices that can be connected to a global synchronization unit (GSU) of the present invention for performing time and space stamping;

FIG. 14 is a schematic representation showing examples of applications that can benefit from inclusion of an embedded global synchronization unit (GSU) in accordance with the principles of the present invention;

FIG. 15 is a schematic representation showing examples of different configurations of a global synchronization unit, including both internal and external units with a variety of interface options;

FIG. 16 is a schematic representation of the time-space (TS) stamping based system for tracking mobile objects, including human beings and articles of property, relative to a globally-defined coordinate reference system, employing ultra-compact and miniaturized global synchronization unit (GSU) enabled client computing/network devices constructed in accordance with the principles of the present invention;

FIG. 16A is a schematic representation of some of the major components of a wireless GSU-enabled client network device in the mobile object tracking system of FIG. 16, shown comprising a global synchronization unit (GSU) 175 and various hardware and software layers, including client software such as a tracking client application 340' and tracking hooks and drivers 350';

FIG. 16A1 is a perspective view of a GSU-enabled client network device of the present invention, shown realized in the form of a wireless security-

tag/address-label having a spring-biased surface-sensing pin provided on the underside of its casing for establishing contact with a package surface when the tag is affixed to the package for object tracking purposes;

FIG. 16A2 is a perspective view of a shipped package to which the GSU-enabled client network device of FIG. 16A1 is affixed for enabling real-time object tracking operations as the package is routed to its destination;

FIG. 16B is a schematic representation of some of the major components of a time-space (TS) stamping based tracking server employed in the system of FIG. 16, shown comprising various hardware and software layers including a TS-stamping based tracking server daemon 270' and GPS receiver 170;

FIG. 16C is a schematic representation of some of the major components of the Web-Based Owner/Object Registration Information Server 110' employed in the system of FIG. 16, including web server software 360' providing support for HTML, Java, and other standard protocols and web technologies;

FIG. 16D is a schematic representation of some of the major components of the Web-Based Object Trajectory Information Server 110'' employed in the system of FIG. 16, including web server software 360'' providing support for HTML, Java, and other standard protocols and web technologies;

FIG. 17A is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 16 during a mobile object tracking process carried out in accordance with the principles of the present invention;

FIG. 17B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 16 during an object movement detection process carried out in accordance with the principles of the present invention;

FIG. 18 is a schematic representation of a database table for storing data relating to the owner of one or more objects, objects owned or controlled by registered owners, and time-space data generated by a mobile GSU-enabled client network device carried by a registered object, and collected by the TS-Stamping Based Tracking Server shown in FIG. 16;

FIG. 19A is a schematic representation of some of the major components of an alternative embodiment of a GSU-enabled client network device carried by a living being (e.g. animal or person) which is being tracked using the time, space and biophysiological stamping (TSB) Based Object Tracking System of FIG. 16, shown comprising a global synchronization unit 175, a biophysiological signal sensor (e.g. pulse sensor, EKG sensor, and/or other biophysiological signal sensor) and various hardware and software layers, including client software such as a tracking client application 340' and tracking hooks and drivers 350';

FIG. 19B is a schematic representation of a wrist-mounted GSU-enabled client network device for use with the TSB-Stamping Based Object Tracking Server shown in FIG. 20, over the network of Fig. 16, wherein a biophysiological signal sensor is incorporated into the GSU-enabled client network device for real-time sensing of biophysiological signals produced from the living being (e.g. animal or person) on which it is carried, and a fractal-based antenna structure is embedded within the housing of the GSU-enabled client network device;

FIG. 20 is a schematic representation of some of the major components of a TSB-Stamping Based Tracking Server employed with the GSU-enabled client network device of FIG. 19B, shown comprising various hardware and software layers including a TSB-Stamping Based Tracking Server daemon 270' and GPS receiver 170;

FIG. 21 is a schematic representation of an exemplary locus of time, space and biophysiological (TSB) coordinates collected by the TSB-Stamping Based Tracking Server shown in FIG. 20 during the process of tracking a living being carrying the GSU-enabled client device of FIGS. 19A and 19B in accordance with the principles of the present invention;

FIG. 22 is a owner/object database table, maintained within the Web-enabled Owner/Object RDBMS, for storing time, space and biophysiological data generated by a GSU-enabled client network device shown in FIGS. 19A and 19B and collected by the TSB-Stamping Based Tracking Server shown in FIG. 20, operating within the system shown in FIG. 20;

FIG. 23A is a schematic representation of an Internet-based method of and system for securing a region of physical space, wherein a GSU-enabled client network device is provided with a CCD-based digital video camera or scanner for capturing images of a field of view (FOV) of the camera or scanner, as well as a sound recording device for recording sound (tracks) within and about the field of view of the camera, wherein each captured image frame is accurately space-time stamped, and recorded on videotape or other digital recording medium;

Fig. 23B is a data table describing the information fields maintained in the Image RDBMS employed in the system of Fig. 23A, wherein TS-stamped images and associated sound recording tracks are stored for analysis and usage in various security operations;

Fig. 24A is a schematic representation of an Internet-based method of and system for securing a computer communications network by embodying a GSU chip of the present invention into each network computing device so that its access to a particular communications/computer network (i.e. subnetwork) or WWW site can be securely enabled a TS-stamping tracking server only upon the generation of a unique time-space stamp by the GSU-chip, achieved when the

GSU-enabled network computing device is physically present at a predetermined location over a particular time interval;

Fig. 24B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 24A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to access a prespecified communication subnetwork or WWW server in accordance with the principles of the present invention;

Fig. 25A is a schematic representation of an Internet-based method of and system for securing a computers communications network by embodying a GSU chip, wherein a GSU-enabled network computing device which is used to access a particular communications (sub)network or WWW site, is partially enabled by the TS-stamping tracking server when the GSU-enabled network computing device is present outside of the predetermined location, or predetermined time interval, so that the TS-stamping tracking server can track to the exact location of the GSU-enabled computing device and authorities can apprehend the person using the same without authorization;

Fig. 25B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 25A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to decrypt and display encrypted message prestored on the GSU-enabled network computing device in accordance with the principles of the present invention;

Fig. 26A is a schematic representation of an Internet-based method and system for enabling "location-and time" based decryption of messages by using a GSU-enabled client computing device of the present invention which is enabled by a TS-stamping tracking server to decrypt certain messages stored on a computer network only at certain times/places (i.e. ranges of TS coordinate data), and at no others, for reasons that need only be known to the author of such messages;

Fig. 26B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 26A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to decrypt and display encrypted radio messages being received by the GSU-enabled network computing device in accordance with the principles of the present invention;

Fig. 27A is a schematic representation of an Internet-based method of and system for displaying information clues or instructions at particular instances

along the space-time continuum, wherein a wireless GSU-enabled client network device (realized for example in the form of a watch or other portable casing having an integrated display screen and keypad) cooperates with a TS-stamping based tracking server through a global communication network so as to enable the GSU-enabled client network device to display information clues and/or instructions only when the GSU-enabled device is present within a specific location over a particular time interval (i.e. intersects a prespecified region along the space-time continuum);

Fig. 27B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 27A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to decrypt and display encrypted messages prestored in memory in the GSU-enabled network computing device in accordance with the principles of the present invention;

Fig. 28A is a schematic representation of an Internet-based method of and system for enabling the operation of set-top cable television boxes, and other digital media content delivery devices, in compliance with license agreements, wherein a GSU-enabled network computing device is embedded within each set-top cable television box, and other digital media content delivery device, in a media content delivery system, and one or more TS-stamping based tracking servers are used to track and control such media content delivery devices so that the media content delivery devices are enabled into operation only when such devices are in fact used in accordance with the conditions of use set forth in the license agreement with the customer (i.e. when used within the particular location specified in the license agreement and during the time duration thereof).

Fig. 28B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 28A, and the predetermined TS-region over which the GSU-enabled media content delivery device is enabled operational by the TS-Stamping Based Tracking Server in accordance with the principles of the present invention;

Fig. 29A is a schematic representation of an Internet-based method of and system for enabling/controlling the operation any portable host system or device which is restricted to operate within a set of space-time constraints, by embedding a GSU-enabled device within each such portable host system or device, and using one or more TS-stamping based tracking servers to track and enable the operation of each such portable host system or device only when

such systems and devices are in fact used in accordance with the conditions of use set forth in the license agreement; and

Fig. 29B is a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 29A, and the predetermined TS-region over which the GSU-enabled media content delivery device is rendered operational by the TS-stamping based tracking server, in accordance with the principles of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS OF THE PRESENT INVENTION

Referring to the figures in the accompanying Drawings, the preferred embodiments of competition-enabling (i.e. competition-promoting) system and method of the present invention will now be described in great detail, wherein like elements will be indicated using like reference numerals.

In FIG. 1, a generalized internetworked-based competition-promoting system is shown for fairly and securely enabling one or more time-constrained competitions among a plurality of competitors simultaneously presented with the same set of data (i.e. in a globally time-synchronized manner) which, in general, may be informative or may take the form of a question to be answered, or a problem, puzzle or riddle to be solved. Hereinafter, this data shall be referred to as an Invitation-to-Respond, or ITR, which is transmitted to each of the competitors participating in the competition promoted by the system hereof in a regulated manner. In general, the competitors can be human beings, programmed computers, or sophisticated androidal machines as taught, for example, in WIPO International Publication No. WO 98/49629 published on November 5, 1998 incorporated herein by reference. In response to each ITR presented to the competitors, each competitor is allowed to respond to the ITR by submitting an appropriate response or undertaking a particular action. In accordance with the principles of the present invention, the timing of each competitor's response is critical to ensuring fairness in the competitive activity in question, and thus precisely measured, securely recorded and analyzed in a manner which will be described in greater detail hereinafter.

In general, the competition-promoting system and method of the present invention can be applied to a variety of different competitive activities with only slight modifications required from embodiment to embodiment of the present invention. Typical applications of the present invention include multi-player timed problem-solving games, puzzles, or contests; on-line real-time auctions, on-line real-time trading of securities (e.g. stocks and bonds), commodities, and

foreign currencies; on-line real-time auctions; on-line educational testing; on-line career testing; on-line aptitude testing; on-line intelligence quotient (IQ) testing; and other real-time activities wherein simultaneous presentation of information to a plurality of competitive entities or accurate presentation of IRQs to and collection of responses thereto from one or more human subjects, is critical to the competitive or otherwise time-constrained activity at hand, in order to ensure fundamental principles of fairness and fair play expected by participants, spectators, and sponsors alike. As used hereinafter and in the Claims to Invention, the term "competition" shall be understood to embrace all such network-enabled activities.

Overview Of The Generalized Embodiment Of The System Of The Present Invention

As shown in FIG. 1, the competition-promoting system of the present invention comprises an integration of subcomponents, such as for example: a primary server 100; one or more web servers 110; a login server 120; a competitor database 30; an Invitation-To-Respond/Response (ITR/Response) database 40; one or more competition-promoting servers 50; and a plurality of client machines 160. As shown in FIG. 1, each client machine 160 includes a global synchronization unit 175 (GSU), whereas each competition-promoting server 50 includes a standard GPS receiver 170. As shown in FIG. 1, the global positioning system employed by the competition-enabling system comprises a plurality of GPS receivers 170 operating in conjunction with an array of GPS satellites 180 occupying a geodesic orbit in a manner well known in the satellite art. All of the computer and database components of the competition-enabling system are interconnected through some sort of internetworked computer communications network 190 such as the Internet.

Overall regulation of the competitive activity enabled by the system and method of the present invention is carried out by a computer or set of computers which hereinafter shall be referred to collectively as the "primary server". The primary server provides certain functionality to the system including, for example: acting as a source of Invitations-to-Respond and other competition related data; providing a master clock for the system; and performing functions or operations involving data received from multiple client machines connected to the system.

In the illustrative embodiments, the single primary server 100 communicates indirectly with the client machines 160 through a number of competition-promoting servers 50. These servers relay Invitations-To-Respond and other data to the client machines 160, and receive responses thereto from

those client machines. Preliminary processing and sorting of the client machine responses is performed by the competition-promoting servers 50, and these pre-processed results are then passed back to the primary server 100.

Each competitor interacts with the competition-promoting system through a client machine 160. Each competitor uses a single client machine to receive and view the Invitations-To-Respond (ITR), as well as to enter and transmit the responses thereto. The client machine typically consists of a standard personal computer, augmented by the addition of several software and hardware components, including a global synchronization unit (GSU) 175 constructed in accordance with the principles of the present invention. The global synchronization unit 175 is installed in the client machine to provide precisely time-stamp client-responses, referred to as client-events, traceable to internationally standardized reference clocks. The GSU within each client machine performs decryption operations, generates digitally-signed time and space stamps of various internal and external events at the client machine, and supports timed decryption and presentation of data to the competitor.

As shown in FIG. 1, the last primary computer-based component of the competition promoting system hereof is the login server 120. The primary function of the login server 120 is to accept login requests from each competitor's client machine and assign an appropriate competition-promoting server to that client machine. The login server 120 also provides a single, well-known address for each client machine to use to contact the assigned competition-promoting server when initializing a session in the competitive activity. The login server also serves to intelligently distribute the processing and communications load among the competition-promoting servers.

As shown in FIG. 1, two database systems are used by the competition-promoting system of the present invention. The first database is the competitor database 30 which records information about each competitor, such as his or her identity, preferences, contact information, and any other data deemed necessary for the proper operation of the competition. The second database is the Invitation-to-Respond/Response database 40 which stores or generates Invitations-To-Respond (ITRs) appropriate to the particular competition being promoted, and transmits those ITR's to the client machine, through the other servers in the system. The ITR/Response database 40 may also contain canonical responses for comparison with the actual responses generated by the competitors, as well as other information necessary for the conducting of the competition.

The final component of system shown in FIG. 1 which deserves mention is the communications network 190. In general, the communications supported by

the communications network 190 could be carried out using a variety of different communications methods. In general, each computer or device in the system will establish a connection or connections to one or more of the other computers through the network 190. In practice, these connections will be "virtual" connections through a general network such as the Internet, rather than as a direct point-to-point physical connection. In the illustrative embodiments disclosed herein, the communications network 190 is a packet-switched data communications network running the popular Transmission Control Protocol/Internet Protocol (TCP/IP). Thus each server computer connected to the communications network 190 will have a statically assigned IP address, while each client machine connected thereto will have either a statically or dynamically assigned IP address in a manner well known in the art.

Contest-Enabling System And Method Of The Present Invention

Referring to FIGS. 2 through 4G, a contest-supporting (i.e. contest-enabling) system and method will now be described in accordance with the principles of the present invention.

In this particular embodiment of the present invention, the primary goal of the Internet-based system and method is to enable thousands and even millions of contestants to participate in a multi-player internetworked problem-solving contest that is regulated in a secure and fundamentally fair manner. In general, the contest will involve a mass population of players, or contestants who simultaneously attempt to solve some problem or set of problems in a time-constrained manner. The contestants are evaluated and ranked according to the solution provided as well as the time taken to submit the solution. Each contestant in the contest will interface to the contest process through a client machine capable of displaying images, text, video, play audio streams in a globally time-synchronized manner, or is otherwise provided with some other means for presenting a question or problem to the contestant in a like manner in accordance with the principles of the present invention. The question or problems thus presented to each competitor will be referred to as a query, although, in a more general sense of the present invention, can be understood as an Invitation-To-Respond (ITR), as discussed hereinabove. Each client machine also accepts an answer or solution from the contestant as response to the query previously presented. The contestant's answer or solution will be referred to as the response, as in the general sense of the present invention. Therefore, each client machine in the contest-supporting system hereof is a device that presents (e.g. visually and/or audibly displays) queries and accepts responses from one registered contestant who is participating in the contest.

The contest-promoting system of the present invention also includes a means for controlling and measuring certain time-based elements of the contest (i.e. competition). For example, such elements include the ability to specify the precise instant at which a query is presented to the contestants on all or some subset of the client machines. Hereinafter, this instant of time shall be referred to as the "start-time", analogous to the "start-line" in a race, which is the same for each contestant in accordance with the principles of the present invention. In addition, the contest-promoting system of the present invention also includes means for precisely determining the length of time between the start-time and the instant each contestant submits its response which, hereinafter, shall be referred to as the "finish-time" analogous to the "finish-line" in the race. Hereinafter, this length of time, measured between the start-time and the finish-time, shall be referred to as the "response-time" of the particular contestant or competitor.

The contest-promoting system and method of the present invention enables the simultaneous presentation of queries (i.e. ITRs) to each and every client machine registered to compete in the contest at hand. Unlike the prior art method of using the receipt of a query decryption key to trigger the display process at each client machine, as disclosed in US Patent No. 5,695,400, the present invention teaches the use of a local clock to determine the exact instant to display the query (i.e. ITR) to the contestant. In the illustrative embodiment of the present invention, the local clock is contained in an embedded or peripheral device known as the global synchronization unit (GSU) 175. The GSU at each client machine incorporates a global positioning system (GPS) receiver to provide a precise timing reference that is accurate to within 1 microsecond of international atomic clock standard time. The GSU can be programmed to decode and present the query (i.e. ITR) in a secure manner at the precise moment desired. In an alternative embodiment of the present invention, a similar functionality can be provided at each client machine, but at lower precision and security levels by using a standard timer, counter, or clock on the client machine. In this alternative, less accurate timing method, the local clock is characterized, or analyzed to determine the functional relationship between the local clock time and the global time as determined by a single master clock for the entire contest system. Using this function, the global time may be determined from the local clock reading. In addition, the display update cycle on each client machine is skewed so that a display update completes exactly at the desired "start time" which is determined to be the same for each every contestant, regardless of their location on the planet. Characterization of the local clock may be performed using an accurate clock (perhaps GPS-based)

connected to the client machine, or it may be done using security enhanced versions of the methods and algorithms used in NTP, the network time protocol.

The contest-promoting system and method of the present invention also provides extensive security measures to detect and discourage cheating by dishonest players. Security is crucial in large contests involving significant rewards for winners. Security for the system is provided through the use of encryption of the majority of messages between the various computers in the system, as well as by monitoring and logging the contest-related activities of participating client machines. Additional details regarding this aspect of the system will be described hereinafter.

Having provided an overview on the contest-promoting system of the present invention, it is appropriate to now describe in greater detail the structure and function of the components of this system.

As shown in FIG. 2, the contest-promoting system of the illustrative embodiment comprises an integration of components, namely: a primary server 100; one or more web servers 110; a login server 120; a contestant database 130; a query/answer database 140; one or more game servers 150; and a plurality of client machines 160. As shown in FIG. 2, each client machine is equipped with a global synchronization unit 175 (GSU), whereas the primary server 100 and each game server 150 is equipped with a standard GPS receiver 170. As shown, the contest-promoting system of the illustrative embodiment employs a global positioning system comprising GPS receivers 170 operating in conjunction with an array of GPS satellites 180 occupying a geodesic orbit in a manner well known in the satellite art. All of the computer and database components of the system are interconnected through some sort of communications network 190 such as the Internet, supporting a networking protocol such as TCP/IP.

Overall regulation of the contest activity enabled by the system and method of the present invention is carried out by a computer or set of computers which hereinafter shall be referred to collectively as the "primary server". The primary server provides certain functionalities to the system including, for example: acting as a source of queries and their correct answers; providing a master clock for the system; determining the overall ranking of contestants; selecting the winner of the contest.; and informing the contestants and possibly the general public of the identity of the wining contestant.

As shown in FIG. 2G, the primary server 100 in the contest-promoting system comprises a number of software and hardware components. As shown in FIG. 2G, the structure of the primary server 100 is described using the layered structure of a standard general purpose computer, wherein the hardware components are shown at the lowest level, with successive layers of software

functionality disposed above them. Each layer of components utilizes and builds upon the services and capabilities of the lower layers, most often only directly interfacing with the layer immediately below it. In the primary server 100, the low level hardware includes a GPS receiver 170, and high precision clock and timing hardware 200 synchronized to a global time reference using the GPS receiver. In addition, the high performance network interface hardware 210 is used to connect the primary server 100 to the communications network 190. These hardware components are in addition to the standard I/O and other hardware 220 typically provided on a high-end network server, such as the SUN Enterprise™ server running the Solaris™ platform, by Sun Microsystems, Inc. of Palo Alto, California. Above the hardware level are standard and customized device drivers 230 that control and communicate directly with the hardware. The device drivers are used by the operating system 240 and higher-level applications so that direct hardware programming is not necessary. At the top level of FIG. 2G are two contest-related applications. The first application is the primary server daemon 250. This piece of software manages the sequence of operations for the contest as a whole, as well as managing the communication of queries, responses, and other information with the game servers. The other top level application running on the primary server 100 is the contest management interface 260. This application provides the user interface to the human operators of the contest. This software allows the operators to enter new questions and answers in to the Query/Answer Database 140, to set up and schedule contests, to set prize levels, to specify qualifications for entering the contests, to collect and view usage statistics, and to monitor ongoing contests. The contest management interface application communicates with the primary server daemon 250 in performing most of its tasks.

As illustrated in FIG. 2A, the single primary server 100 communicates indirectly with the client machines 160 through a number of game servers 150. These game servers relay queries to the client machines, and receive responses from those client machines. Preliminary judging and sorting of the responses is performed by the game servers 170, and these pre-processed results are then passed back to the primary server 100.

As shown in FIG. 2E, the game server 150 has a layered architecture similar to the primary server 100, comprising: hardware components including a GPS receiver 170; high precision timing hardware 200; a high performance network interface 210; in addition to the standard hardware components 220. These hardware components are controlled through the use of a set of standard and customized device drivers 230. Many of these device drivers are provided by the hardware manufacturers, while some are specifically written or modified

to handle the precise timing operations needed by the contest-promoting system of the present invention. The major application running on the game servers is the game server daemon 270. The game server daemon 270 receives, processes and responds to data from the primary server 100, the login server 120, and from its client machines 160.

Each contestant interacts with the contest system through a client machine 160. Each contestant uses a single client machine 160 to receive and view the contest queries as well as to enter and transmit their responses containing their answers to those queries. In the illustrative embodiment, each client machine may be realized as a standard personal computer, augmented by the addition of several software and hardware components. In FIG. 2D3, the basic components of each client machine 160 is shown. As shown in FIG. 2D3, each client machine 160 would initially comprise the standard hardware and software components typically associated with any personal computer. These components would include the operating system 240, standard device drivers 280, clock or timer hardware 290, input hardware, such as the keyboard, mouse, a microphone, etc. 300, output hardware, such as a video display and/or speakers 310. In addition to this hardware, each client machine would also require some sort of "web browser" 320 such as Netscape Navigator or Microsoft's Internet Explorer. This web browser is used to contact the "Contest WWW Site", to register with the contest system, and to download the other software components therefrom. These other components might include a contest plug-in 330 that would enhance the user's experience at the contest web site, in addition to the contest client 340, which is the primary interface between the contestant and the contest system. Each contest client receives and presents queries to the human contestant, as well as accepting the contestant's responses and sending them to the servers. Each contest client communicates through contest hooks and drivers 350 with the underlying input, output, and timing hardware, in order to handle the timing aspects of the game (i.e. contest). The hooks and drivers 350 are responsible for clock and display synchronization, as well as for generating time-stamps associated with various events during the game. The global synchronization unit 175 is installed in the client machine to provide precisely timed events, traceable to internationally standardized reference clocks. The GSU 175 performs decryption operations, time-stamping of client-machine/contestant responses, and supports timed query presentation.

When not actually playing a game, the contestant interacts with the contest web site through a web browser. The contest web site is "served" to that browser from one or more web servers 110. The web servers handle advertising, support, registration, downloading, and other similar tasks. As shown in FIG. 2F,

the web server 110 comprises a number of major components comprising a standard I/O 220; a high performance network interface 210; standard device drivers 280; and the operating system 240. These components cooperate to support the operation of the web server software 360. The web server software 360 consists of an HTTP daemon, along with various scripts and utility programs used to handle user/contestant registration and to perform contest web site updates as new contests or results information become available.

As shown in FIG. 2, the last primary computer-based component of the contest-promoting system is the login server 120. The function of the login server 120 is to accept login requests from each contestant's client machine, and assign an appropriate game server to that client. The login server 120 provides a single, well-known address for the client machines to contact when initializing a new game. The login server also serves to intelligently distribute the processing and communications load among the game servers. As shown in FIG. 2H, the login server 120 comprises a number of major components, namely: a standard I/O 220; a high performance network interface 210; standard device drivers 280; and the operating system 240. These components cooperate to support the operation of the login server daemon 370, which handles the login requests and server assignment functionality within the contest-promoting system.

As shown in FIG. 2, the contest-promoting system of the illustrative embodiment employs two database systems. The first database system is the contestant database 130. The contestant database records information about the user, such as their identity, preferences, contact information, and contest results and standing. The second database is the query/answer database 140. The query/answer database stores the problems and solutions for the game contests. These problems and solutions are originally created and stored in the database by the contest operators. They are then accessed and distributed by the primary server 100 to the contestant's client machines 160 during the contest.

As shown in FIG. 2, the final component contest-promoting system that deserves mention is the communications network 190. In general, communications over the network could be carried out using a variety of different communications methods. In general, each computer or device will establish a connection or connections to one or more of the other computers through the network 190. In practice, these connections will be "virtual" connections through a general network such as the Internet, rather than as a direct point-to-point physical connection. The topography of the primary virtual connections between the various contest system components are depicted

in FIGS. 2A, 2B, and 2C, while the information flows transmitted through those connections are detailed in FIGS. 3A through 3G.

Virtual Communication Links And Hierarchies In The Contest Promoting System Of The Present Invention

Typical games implemented using the contest-promoting system of the present invention could involve thousands or even millions of contestants distributed over and possibly above the planet Earth. Because of the huge bandwidth required to handle transmission of the queries and responses from all of the client machines employed in the contest, the system of the present invention utilizes a hierarchy of servers illustrated in FIG. 2A. As shown in FIG. 2A, the primary server 100 acts as the root node of a tree-type interconnection of computers. The "leaves" of the tree structure are formed by the client machines 160 connected to the system. Between these devices lies a layer of game servers 150 which act as intermediaries (or "branch structures") between the primary server 100 and the client machines 160. Each game server communicates directly with the primary server 100 and with a set of client machines associated with that particular game server 150. In a large contest involving many thousands of contestants, there might be hundreds or thousands of game servers deployed in the system, each handling hundreds or thousands of client machines. These game servers could be distributed over the country or over the world, with each game server handling client machines in a certain region, thereby greatly reducing the communications loading on central "trunk" network links. As shown in FIG. 2A, there are also communication links between the primary server 100 and the contestant database 130 and the query/answer database 140. In this illustrative embodiment of the contest-promoting system hereof, each game server 150, client machine 160, and primary server 100 is equipped with a GPS receiver that is used to synchronize the local clock and the display of each client machine participating in the contest-promoting system.

Network traffic bandwidth associated with the higher level servers in the hierarchical configuration shown in FIG. 2 is reduced by performing some data processing on the game servers 150 themselves, rather than performing all computations on the primary server 100. For example, if a single winning contest, or a certain number (e.g. n) of winners are to be chosen in each contest, then each game server 150 can compare each response it receives and only transmit the "n" best responses onto the next higher level server. Also, management of time synchronized messaging with each client machine can be carried out by the game server 150 associated with that client machine, rather than by the primary server 100. Such techniques will serve to reduce the

loading on the primary server 100. If the performance of all contestants is to be rated and sorted, then each game server 150 can sort the contestants playing on the client machines connected to that game server 150. Thereafter, these sorted lists of client machines can be easily and efficiently sorted by the primary server 100 using an insertion sort or method that takes advantage of the pre-sorted groups of contestants.

It is recognized that real world contests involve much more than the actual queries and responses that make up the core elements of the game. Many other steps and processes are necessary or desirable both from the point of view of the contestant, as well as from the point of view of the person or company running the contest. While the purpose of the contest from the point of view of the contestant is to have fun, to learn, or to win prizes, the purpose of the contest from the point of view of the contest operator may include other goals. For example, such goals may include: selling products; advertising; collecting marketing information or other statistical information; promoting their company or institution; educating a group of people; and so on. The basic query, response, and judging activities constitute the contest itself, while the other activities referred to above will be referred to as the non-contest activities. These non-contest activities can be divided into two major categories; those activities that directly support the operation of the contest; and those activities that are ancillary to the contest.

Non-contest activities that directly support the operation of the contest include one-time or rarely performed activities, as well as activities that must be performed immediately before or after each contest. One-time activities include contestant registration, system testing and qualification, and downloading plugins or other client-machine based components. Those periodic activities that must be performed before or after each contest include login, server assignment, and viewing contest results.

Registration is used to collect and record information about each contestant desiring to participate in a scheduled contest (e.g. listed on the Contest WWW Site) . This information can include the name, address, telephone number(s), E-mail address, and any other information required or desired of each contestant by the contest organizer and/or sponsor(s). The contestant chooses or is assigned an identification number (or "handle") and a password, in order to protect their access to the contest process. At registration time, a number of tests may be performed on the contestant's system. These tests could be used to qualify the client machine to be used by the contestant, by determining whether it meets certain requirements necessary to successfully participate in the contest. In addition, data produced as a result of these tests

may be recorded, either on the client machine or on one of the servers. This data could be used, in conjunction with other information collected during and/or after the contest, to help determine whether the contestant participated fairly in the competition. Another activity which is also performed before the contest is downloading any programs, installable components, and plugins, as well as any data required by them. These programs, components, and plugins, along with a browser or other programs already present on the contestants system will be used to present advertising and other information and content to the contestant, as well as to perform all operations of the contest on the client machine.

As shown in FIG. 2B, a number of system components are used to distribute and present HTML (or XML) encoded documents (with or without Java or Active-X applets) and associated web content to the contestants. As shown, such system components include a plurality of mirrored web servers 110, wherein each web server 110 is connected to a contestant database 130 and each serves a set of Web-enabled client machines 160 equipped with web browsers 320. A master web server 110 stores and provides the web site content to a set of client machines, utilizing HTTP, FTP, and other standard Internet protocols. In order to avoid overloading a single web server with many thousands or millions of connections, a number of mirror web servers 110 are used. The master web server transmits copies of the entire contest web site to the mirror web servers, which then are each able to serve a large number of client machines 160. As shown, each of the web servers 110 shares a common networked contestant database 130 which contains registration and other information. In addition to providing the contest "web site", the web servers also distribute the contest client software (340) using the HTTP or FTP protocols. Before downloading contest client software, each contestant/user is required to register on the web server 110. Registration involves filling out a web-based (e.g. HTML-encoded or XML-encoded) form containing the necessary personal and client machine information and submitting that form to the web server. Client machine qualification may be tested using either browser plug-ins or stand alone test programs downloaded from the web server.

In an extremely large multi-player contest, it is clear that multiple game servers will be necessary to handle communication with all the client machines involved during the contest. When a client machine initially connects to the contest-promoting system of the present invention, it will be done through a login server 120 located at some well-known Internet address. The login server will choose which game server should be utilized by this contestant's client machine. This choice will be based on a variety of information, including the

location of the client machine, the characteristics of the connection to the client machine, and the number and characteristics of the connections already assigned, or anticipated to be assigned, to the game servers in the system. Load balancing algorithms will be used to distribute the connections to the game servers, thereby minimizing the possibility of overwhelming any one server, and insuring consistent connections for all the game clients.

FIG. 2C depicts the connections between the client machines 160, login server 120, and the contestant database 130. Except in extremely large configurations, it is probable that only a single login server would be needed, and all client machines would receive their game server assignments from that server. If a single login server is insufficient, then a hierarchical configuration similar to the one shown for the game servers in FIG. 2B could be used. As shown in FIG. 2C, each client machine is running the contest client 340, and it is this software that the contestant interfaces with when logging in to through the login server. In order to check passwords and the status of the contestant, the login server accesses the contestant database 130.

Global Synchronization Unit (GSU) Of The Present Invention

While an optional component of the contest-promoting system described above, the global synchronization unit (GSU) 175, when used in each client machine 160, will greatly enhance the precision and security of the overall system. In general, the GSU 175 is a standalone system with important capabilities and many potential applications beyond the contest-promoting system of the present invention herein disclosed. The basic purpose of the GSU 175 is to either (i) perform actions in response to precise time and space conditions, or (ii) generate secure and verifiable time and space-stamped records of client-machine inputs and any other events captured by devices attached or otherwise connected to the GSU of the present invention.

In general, the GSU 175 has the ability to trigger or generate an event at a specific time instant or over a specific time interval. This event could be the display of an image, the start of a video or audio clip, the decryption of data, or the running of a program on the host machine. One purpose of this capability is to allow the synchronization of events on multiple client machines, each of which is equipped with a GSU. In situations requiring high security, data used in the generation of the event may be downloaded into the GSU in an encrypted form. This data is then decrypted and the event-triggered by the GSU at the precise instant desired.

In addition to triggering events based on time or time interval conditions, the GSU of the present invention can also trigger events at a client machine

based on their location or velocity of the GSU, or on any combination of time, space, and velocity conditions thereof. In all cases, the GSU is configured through the host computer interface to perform a specific action when those conditions are satisfied.

Another major functionality of the GSU is to perform time and space stamping of external events. These events could be as simple as a communication line being asserted on the GSU input, or as complex as a set of patterns of inputs on a number of different inputs. The trigger for a time and space stamping action could constrained by timing, location, and velocity conditions of the GSU. In fact, the space and time stamp generation could even be triggered solely by internal information, for example, generating a time/space stamp upon the arrival of the GSU at a specific location, or at a predetermined time. In accordance with the principles of the present invention, a time/space stamp generated by the GSU 175 includes the location, exact time (e.g. to within +/- 1 microsecond), and security information including, but not limited to, a hash or CRC (cyclic redundancy check) value derived from the input data associated with the event. The hash value will allow the data to be verified in the future to insured that it has not been altered since the time/space stamp was generated. The time/space stamp also will have an associated CRC value or digital signature to insure that the time/space stamp itself is genuine and unmodified.

The GSU of the present invention also provides the ability to authenticate digitally signed time and space stamps that it has previously generated, and to verify that data associated with that time and space stamp has not been modified since the stamp was created.

Applications of the GSU include, by are certainly not limited to: managing and judging geographically distributed race-based (i.e. time-constrained) contests; notarization of data; time-space stamping of executed legal documents (e.g. contracts, property transactions, patent applications, security interests, etc.) and transmitting the same to a centralized server for public recordation and/or filing in accordance with governmental or legal regulations; controlling, distributing, and authorization of lottery tickets and the like; and any other task in which precise, secure, and verifiable timing of events and triggering of timed events are required.

The Structure And Function Of The Basic GSU Of The Present Invention

FIG. 2D1 depicts one context of operation for a basic GSU. This figure shows a client machine 160 with attached input and output devices. This client machine is connected (using a direct hardware connection or infrared or radio

frequency link) to a global synchronization unit (GSU) 175. In addition, the client machine 160 is connected through the Internet or other communication means 190 to a server equipped with a GPS Clock 170. In this context, the server could send an encrypted request to the client machine 160 to perform an action (for example displaying an image) at a specific time, as required in the contest-promoting system described hereinabove. This encrypted request is then loaded into the GSU 175 where it is decrypted and the desired event time recorded. At, or at some predetermined time before, the desired display time, the GSU 175 decrypts the image to be displayed and downloads the decrypted image back onto the client machine 160 for display. This method prevents access by the client machine or its operator to the image data before the allotted time.

An alternative function performed by the GSU in the context of FIG. 2D1 would be the ability to time and space stamp an input or event captured or generated by the client machine. In this case, data associated with the client input or client event data would be uploaded to the GSU 175. The GSU uses digital signature techniques to create (i.e. compute) a digital signature for the set of data comprising: the client input event data; and the time and location data of the GSU at the time of data upload. Notably, the time of the client input or client event will be expressed in terms of a globally time-synchronized time measure, whereas the location of the client input or client event would be expressed in terms of a globally referenced space/location measure. The set of data and the computed digital signature applied thereto produces a digitally signed data package. The digitally signed data package is then be sent over the network to a server to serve as a record of the event taking place. At a later time, this record could be used to prove that the data existed at or before the time recorded in the time-stamp, and the location of the GSU when the record was generated.

As shown in FIG. 2D2, a basic global synchronization unit (GSU) 175 comprises several required and optional components. The required components include a GPS Receiver 700 and an associated antenna 730. The GPS receiver 700 is connected to a central processor 750 that can store events and desired trigger time/locations, perform encryption and decryption functions, and calculate digital signatures verifying the authenticity of data including, for example, time and space information provided by the GPS receiver 700. Access to the central processor 750 is provided through a host computer interface 720, which could utilize standard or proprietary hardware and communication protocols to provide such access. Standard interface specifications that might be utilized therein include bus-based connections such as ISA, SCSI, or PCI; port-based connections such as USB, RS232, or PCMCIA; or other communication methods such as infrared or radio frequency links. In addition to these core

components, the GSU of the present invention may also contain a number of optional components such as a high-frequency GPS disciplined clock 710, interfaced with the central processor 750, for providing much higher resolution time-stamps; a stand-alone encryption and decryption module 740, interfaced with the central processor 750, for providing enhanced speed and security; and/or non-volatile memory 760, interfaced with the central processor 750, for recording time-stamps for later comparison and verification purposes. As discussed above, FIG. 2D3 shows the GSU in the context of a client machine for use in a time-constrained competition against others, as in the case of a contest, or against oneself under the constraint of a clock as the case of testing, or against changing supply and demand conditions in a market as in the case of real-time securities, commodities, or currency trading, or other forms of real-time and non-real-time auction processes.

The Structure And Function Of The Enhanced GSU Of The Present Invention

FIG. 2D4 depicts one context of operation for an enhanced version of the GSU. As shown therein, a client machine 160 is connected to the GSU 177 using either a direct hardware connection or infrared or radio frequency link known in the art. Instead of being directly connected to the client machine, the input and output hardware for the client machine is routed through the GSU 177. As shown, the client machine 160 is connected through the Internet or other communication means to an information server equipped with a GPS Clock 170. In this context, the server could send an encrypted request to the client machine 160 to perform an action (for example displaying an image) at a specific instant of time. This encrypted request is then loaded into the GSU 177 where it is decrypted and the desired event time recorded. At the desired display time, the GSU 177 can directly override the video output from the client machine 160, replacing it or overlaying it with the decrypted image. The enhanced GSU 177, by directly controlling the client machine display, can provide even more precise output event timing. In addition, security is enhanced because the decrypted image data is never actually sent to the client machine 177.

An alternative function which can be performed by the enhanced GSU 177 of the present invention, in the context of FIG. 2D4, would be the ability to time and space stamp an input or event captured or generated by input devices to the GSU 177 without the delays and security risks incurred by first passing the data inputs to the client machine 160. Thus, the enhanced GSU 177 provides much higher precision of data event timing at a client machine because the data inputs are fed directly through, and directly monitored by, the GSU 177.

As shown in FIG. 2D5, the enhanced GSU 177 of the present invention comprises several required and optional components. As shown therein the required components include a GPS Receiver 700 and an associated antenna 730. The GPS receiver 700 is connected to a central processor 750 that can store events and desired trigger time/locations, perform encryption and decryption functions, and calculate digital signatures verifying the authenticity of data including, for example, time and space information provided by the GPS receiver 700. Access to the central processor 750 is provided through a host computer interface 720, which could utilize standard or proprietary hardware and communication protocols to provide such access. Standard interface specifications that might be utilized include bus-based connections such as ISA, SCSI, or PCI; port-based connections such as USB, RS232, or PCMCIA; or other communication methods such as infrared or radio frequency links.

Unlike the basic GSU 175 described above, the enhanced GSU 177 also includes at least one of the following two components: an input device passthrough monitoring module 770; and an output passthrough and signal generation module 780, as shown in FIG. 2D5.

The function of the input device passthrough monitoring (IPM) module 770 is to provide a "passthrough" (e.g. input and output port) for a specific input device or class of input devices. The IPM module 770 will monitor the data passing through, and generate digital signatures or CRC values of the data when requested by the central processing unit 750. In addition, the IPM module 770 could be programmed by the central processing unit 750 to trigger the acquisition of a time/space stamp or other event upon the receipt of a specific input or pattern of input of data into the IPM module 770. The IPM module 770 could be manufactured to interface with any type of input device, including a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, or any other analog or digital data input device.

The function of the output passthrough and signal generation (OPSG) module 789 is to provide a passthrough (e.g. input and output port) for a specific output device or class of output devices. The OPSG module 780 will have the ability to block signals from the host computer passing through the GSU 177, and to insert or overlay its own signals for presentation on the output device. For example, the OPSG module 780 could be used for the video display device. The host computer video output would be connected to the GSU 177, and another cable connected from the GSU 177 to the display device. The GSU could then "take over" the display device and display its own images or videos on the display device. Typically this capability would be activated in response

to a timed event, in order to simultaneously display output on multiple GSU-equipped client machines (e.g. e.g. operating within a competition-supporting system of the present invention). OPSG modules 780 could be created to interface with a number of different output devices, including video displays, speakers, or printers.

In addition to these required core components, the enhanced GSU 177 may also contain a number of optional components such as, for example: a high-frequency GPS disciplined clock 710, interfaced with the central processor 750, for providing much higher resolution time-stamps; a stand-alone encryption and decryption module 740, interfaced with the central processor 750, for providing enhanced speed and security; and/or non-volatile memory 760, interfaced with central processor 780, for recording time-stamps for later comparison and verification purposes.

Processes Involved During The Operation Of The Contest-Promoting System Of The Present Invention

In FIG. 4, the high level operations performed by the contest-promoting system of FIG. 2 are described. Collectively, these operations enable a contestant to compete many other contestants, in a secure and fundamentally fair time-constrained contest, wherein each contestant is provided with a common "start-time" regardless of the location of his or her client machine on the infrastructure of the Internet, for the type of interconnection provided thereto (e.g. POTS line, ISDN, frame-relay or T1 line). The flowchart of FIG. 4 sets forth the seven basic steps or operations carried out by the contest-promoting system of FIG. 2. These operations are indicated at Blocks A through G in FIG. 2. As a overview of the method hereof, these operations will be first briefly described below, and thereafter, each operation will be described in greater detail with reference to FIGS. 4A through 3G, respectively.

As indicated at Block A in FIG. 4, the first major operation carried out by the contest-promoting system hereof involves registration of each user as a contestant, and the creation of a globally-synchronized and secure networked client machine through which the contestant may participate in a time-constrained question and answer type contest, while competing against large numbers of other contestants for potentially high stakes.

As indicated at Block B in FIG. 4, the second major operation carried out by the contest-promoting system hereof involves the contestant using the contest client software on the client machine to log on to the game server 150, and the establish a communication channel therewith.

As indicated at Block C in FIG. 4, the third major operation carried out by the contest-promoting system hereof involves transmitting the query and start-time from the primary server to the client machine.

As indicated at Block D in FIG. 4, the fourth major operation carried out by the contest-promoting system hereof involves characterization of the client machine's local clock with the master clock on the primary server, and the synchronization of the client machine display update cycle with the desired start-time for the contest.

As indicated at Block E in FIG. 4, the fifth major operation carried out by the contest-promoting system hereof involves presenting the query to the contestant precisely at the start-time, as determined by a local clock that is characterized with respect to a global master clock located on the primary server.

As indicated at Block F in FIG. 4, the sixth major operation carried out by the contest-promoting system hereof involves accepting the contestants response, attaching a time-stamp to that response, and transmitting the response and time-stamp to the servers.

As indicated at Block G in FIG. 4, the seventh major operation carried out by the contest-promoting system hereof involves judging the responses from all the contestants and determining the winner. In addition, each contestants standing or rank is determined for the contest.

Details Relating The Operation Specified In Block A In Fig. 4

In FIG. 4A, the suboperations are shown for carrying out the method of registering and downloading of contest software indicated at Block A in FIG. 4.

As indicated at Block A in FIG. 4A, a potential contestant browses the contest WWW site ("the contest web site"). In general, the contest web site will include information about the contest, including descriptions of the contest client software, contestant qualifications, contest regulations, instructions on how to play, information about different varieties of the contest, lists of prizes and awards offered, advertising, lists of contest sponsors, lists of previous winners, and the standings or ranks of other contestants. FIG. 3A indicates the flow of information between the user's client machine 160 and the web server 110 containing HTML (and/or XML) encoded documents comprising the contest web site. In this figure, as well as in FIGS. 3B through 3G, the large arrows extending from one computer to another represent a message or group of messages containing related information. Messages indicated by 400 in FIG. 3A contain the web content being delivered to the client machine 160 from the web server 110.

In addition to the informational content of the contest web site, provision will also be made to allow the user to register to become a contestant. As indicated at Block B in Fig. 4A, upon deciding to enter the contest, the user fills out an on-line registration form, using either standard HTML (or XML) forms, or forms generated by Java or Active-X applets, or by a CGI script in a manner well known in the art. During the registration process indicated at Block B in Fig. 4A, there may also be a qualification procedure, wherein the user performs some test either of their own abilities and/or of the capabilities of their computing system. These tests could be administered through forms along with the registration process, or could involve the user downloading and running customized plug-in modules or stand-alone applications on his or computing system. Message 405 in FIG. 3A contains registration information being transmitted from the client machine 160 to the web server 110. This information is encrypted using standard secure HTTP methods known in the art.

As indicated at Block C of FIG. 4A, the web server 110 creates a record in the contestant database 130 for this user upon completing receipt of the registration information therefrom. The registration information is stored in this record, establishing the user as a contestant permitted to participate in one or more on-line multi-player contests to be promoted (i.e. enabled) the system of the present invention.

As indicated at Block D of FIG. 4A, a contestant ID is then assigned to the new contestant. This ID code uniquely identifies the contestant for all time, unlike a username, password, e-mail address or other information that may be changed in the future by this player/contestant. The contestant ID is recorded in the contestant database 130, and is used internally by the contest software of the system.

As indicated at Block E in FIG. 4A, the contestant is assigned a username and a temporary password for use when playing the contest. The username may be assigned by the system, or it may be chosen by the user as a part of the registration procedure. The password is generated randomly, and will most likely be changed by the contestant after logging into the system the first time. The username and password are stored in the contestant database 130.

As indicated at Block F in FIG. 4A, an e-mail message containing the username and temporary password are sent to the contestant. This e-mail message from the web-server 110 to the client machine 160 is depicted as Message 410 in the data flow process shown in FIG. 3A.

As indicated at Block G in FIG. 4A, the contestant logs onto a secure, members-only area of the contest web-site using his or her username and temporary password. This area allows the contestant to view and update his or

her personal information (e.g. username, password, e-mail address, residence address and telephone numbers, and so on).

As indicated at Block H in FIG. 4A, the contestant downloads the contest software from the web server 110 to his or her client machine 160, i.e. from the members-only area of the contest web site. This contest software download is accomplished using HTTP, FTP, or other file transfer protocol, as represented by Message 415 shown in the information flow proceeds of FIG. 3A.

As indicated at Block I of FIG. 4A, the contestant installs the client software on his or her machine. This procedure will involve either executing the downloaded installation file, or initially decompressing the downloaded file and then executing a setup application contained within the compressed archive. The installation procedure will install the contest client 340 application, as well as one or more customized device drivers 350 required by the contestant's client machine. The device drivers will be used to communicate directly with the local clock and any timing hardware (GPS, etc) used in the client machine. Upon successful installation of the client software, the contestant's computing system will become a fully enabled "client machine", and thus ready to participate in a contained competition in accordance with the principles of the present invention.

Details Relating The Operation Specified In Block B In Fig. 4

In FIG. 4B, the suboperations are shown for carrying out the method of logging a contestant onto the game server 150 indicated at Block B in FIG. 4. In general, this procedure involves a number of "behind-the-scenes" activities by the various server systems, in addition to the actual log on process. Initially, all servers and clients in the system are provided with the address of the login server 120 as well as with the login server's encryption "public key", which is used to send secure message to the login server.

As indicated at Block A in FIG. 4B, the primary server 100 transmits a list of all the participating game servers to the login server 120. This message, shown as 420 in FIG. 3B, is encrypted using the login server's public key. The login server 120 decrypts and stores this message using its private key.

As indicated at Block B in FIG. 4B, the login server sends a status request message to each of the game servers. In FIG. 3C, this status request message is indicated by Message 425.

As indicated at Block C in FIG. 4B, each game server 150 sends a reply in response to the status request message (i.e. Message 425), containing information about the status of the game server, including current loading, indications of maximum server capacity, geographical area of coverage, and

other information. In addition, this reply contains the game server's public encryption key. The entire reply, indicated by Message 430 in FIG. 3C, is encrypted using the login server's public key. Status request message 425 and response message 430 occur during the initialization of the contest system, as well as periodically throughout the operation of each contest enabled by the system hereof.

As indicated at Block D in FIG. 4B, the contestant must log on to the system using the contest client application when the contestant decides to participate in a particular contest. During this stage of the process, the contest client machine 160 requests a username and password from the contestant for the convenience of the contestant. This username and password may be stored locally on the client machine to avoid the contestant having to re-enter the username and/or password every time he or she plays a game or participates in a contest.

As indicated at Block E in FIG. 4B, the contest client software 340 transmits the username and password to the login server 120. The username, password, and the client machine's public key are first encrypted using the login server's public key, and the resulting login request, indicated as Message 435 in FIG. 3D, is sent from the client machine 160 to the login server 120.

As indicated at Block F in FIG. 4B, the login server 120 decrypts the login request, obtaining the username and password. The username and password are obtained by performing a lookup operation in the contestant database 130, thereby obtaining a contestant ID.

As indicated at Block G in FIG. 4B, the contestant ID is transmitted to the client machine 160, as Message 440 shown in FIG. 3D. The client machine 160 stores this ID for later use.

As indicated at Block H in FIG. 4B, the login server 120 selects an appropriate game server 150 for this contestant, based on loading, geographical location, and other factors.

As indicated at Block I of FIG. 4B, upon selecting a game server, the login server 120 sends a login request, indicated as Message 445 in FIG. 3C, containing the contestant ID and the client machine address to the selected game server. This message 445 is encrypted using the game server's public key. If the login request is granted, then the game server 150 creates a message containing a game server access code, indicated as Message 450 in FIG 3C, encrypted using the login server's public key.

As indicated at Block J in FIG. 4B, this message (containing the game server access code) is sent from the game server 150 to the login server 120. Notably, the game server access code is a key created using the contestant ID

and the client machine address. This code will only allow the specified contestant to log in using that code.

The login server decrypts Message 450, and then creates a new message, indicated as Message 455 in FIG. 3D, containing the game server's address and the game server access code. As indicated at Block K in FIG. 4B, Message 455 is encrypted using the client machine's public key, and sent from the login server 120 to the client machine 160.

The client machine decrypts Message 455 containing the game server address and the game server access code using its private decryption key. The client machine then creates a message, indicated as Message 460 in FIG. 3D, containing the contestant ID, the game server access code, and a client machine public encryption key. As indicated at Block L in FIG. 4B, Message 460 is sent from the client machine 160 to the game server 150 specified by the game server address received from the login server 120. The game server 150 responds with Message 463 containing the game server public key. At this point, the client machine 160 has successfully logged on to the game server 150 chosen for the client machine by the login server 120.

Details Relating The Operation Specified In Block C In Fig. 4

In FIG. 4C, the suboperations are shown for carrying out the method of downloading an encrypted query and start-time to the client machine indicated at Block C in FIG. 4.

All of the contest questions and answers originate with the game/contest designers who typically will be human beings, although not necessarily the case for all types of time-constrained competitions.

As indicated at Block A in FIG. 4C, human operators enter the questions and associated answers relating to a particular contest into the query/answer database 140.

As indicated at Block B in FIG. 4C, at some point before the contest begins, the game server 150 sends to the primary server 100, a message, indicated as Message 465 in FIG. 3F, containing its public encryption key. Similarly, as indicated at Block C in FIG. 4C, the primary server sends to the game server 150, a message indicated as Message 470 in FIG. 3F, containing its public encryption key.

As indicated at Block D in FIG. 4C, when a particular contest is created, the human operators, accessing the system through the contest management interface 260, select queries from the database to be used in the contest. For each query, the operator assigns a desired start-time. Selecting queries and

assigning start-times could also be done automatically by the contest management interface software.

As indicated at Block E in FIG. 4C, for each query and start-time, the primary server generates a unique set of query encryption and decryption keys.

As indicated at Block F in FIG. 4C, using the query encryption key, the primary server 100 encrypts the query.

As indicated at Block G in FIG. 4C, the primary server 100 creates a message, indicated as Message 475 in FIG. 3F, containing the encrypted query, the query decryption key, and the desired start-time.

As indicated at Block H in FIG. 4C, the entire Message 475 is encrypted using the game server's public encryption key.

As indicated at Block I in FIG. 4C, the entire Message 475 is sent from the primary server 100 to the game server 150.

As indicated at Block J in FIG. 4C, upon receiving the Message 475 from the primary server 100, the game server 150 decrypts the Message 475 and creates a new message, indicated as Message 480 in FIG. 3F.

As indicated at Block K in FIG. 4C, this new Message 480 is encrypted by the game server using the client machine's public key.

As indicated at Block L in FIG. 4C, the resulting encrypted Message 480 is sent to the client machine.

As indicated at Block M in FIG. 4C, the client machine decrypts the Message 480, and stores the encrypted query contained within, along with the start-time on the client machine 160.

At this point, the client machine 160 creates and begins appending data to a security verification log file. This encrypted file will contain a variety of information about the timing of the query/response process. Among other data, the security verification log will record the arrival-time (in local time) of the encrypted query from the game server 150.

Details Relating The Operation Specified In Block D In FIG. 4 When Using Basic GSU Of The Present Invention

In FIG. 4D, the suboperations are shown for carrying out the method of characterizing the client machine's local clock and synchronizing the client machine display update cycle indicated at Block D in FIG. 4 for a system that utilizes a basic GSU 175. When using a GSU, there is no need to characterize the local clock, and the only procedure necessary is to adjust the display refresh cycle such that a cycle completes precisely at the desired start-time.

The GSU of the present invention is used to measure the video refresh rate of the video display adapter. Almost every video display adapter used in

personal computers has a set of registers used to control and monitor the scanning and refresh periods and rates. One standard function is the ability to query the adapter to determine whether it is currently in a vertical retrace period or not. By using this function over a period of time, and recording the local clock time each time the display enters vertical retrace, the period and phase of the display update cycle is determined with respect to local clock time. By reading the display adapter registers, it is simple to determine the difference between the time the last line of the displayed image is drawn and the beginning of the next vertical retrace. The instant that the last line of the display is drawn in any display update period will be referred to as the display time (t_d). Using this calculated period and phase, the display times are extrapolated forward in time to find the display time closest to the desired start-time. As indicated at Block A in FIG. 4D1, the error (E_d) between the display time (t_d) and the desired local clock start time (t_{sl}) is calculated. Throughout this process, the times associated with each vertical retrace are appended to the security verification log.

Since it is desired to have the client machine display the query simultaneously on all client machines (i.e. at the common start-time), the error term E_d is minimized by shifting the phase of the display update cycle. A value of 0 for E_d indicates that the display will complete drawing the given image at the precise moment of the start-time. The phase of the display update cycle is adjusted by increasing or decreasing the display update period over a number of update cycles. This period is typically determined by several registers on the display adapter, controlling the so-called "vertical total", "horizontal total", and the "dot clock". The vertical total is the total count of lines, both displayed and non-displayed (within the vertical blanking and retrace period), that make up one display update cycle. Similarly, the horizontal total measures the number of pixels, both displayed and within the horizontal blanking and retrace period. The dot clock frequency determines the number of pixels per second rendered to the display. By adjusting any one of these three values temporarily, the period of the display update cycle may be changed, again temporarily. Although it might be possible to align t_d with t_{sl} within a single update cycle, it is probably not desirable to make such a large modification to the display update period, since this can cause monitor clicking and may temporarily disrupt the displayed image. Instead, the display update period is modified only slightly (perhaps adjusting the vertical total by one or two lines), and the period is left adjusted until enough phase shift accumulates to reduce E_d to near zero, at which time the display update period is restored to its original value. As indicated at Block B in FIG. 4D1, the client machine adjusts the display update cycle over a number of

cycles in order to minimize E_d and completely display the query at the desired start-time.

Note that depending on the accuracy of the clocks, the frequency drift of the clocks and the refresh update cycle, and the distance into the future that the display time is extrapolated, it may be necessary to repeat the alignment procedure to reduce these errors. The display time alignment procedure should be considered an ongoing process, perhaps being performed concurrently with other steps in the contest process. As always, information about this process is recorded in the security verification log, providing a continuous trace of the operations taking place and the timing of those operations.

Details Relating The Operation Specified In Block D In FIG. 4 When Using The Enhanced GSU Of The Present Invention

In FIG. 4D, the suboperations are shown for carrying out the method of synchronizing the client machine display update cycle indicated at Block D in FIG. 4, for a system that utilizes an enhanced GSU 177. When using an enhanced GSU 177, there is no need to characterize the local clock. In addition, the display monitor is connected directly to the GSU 177, with the video signal from the client machine being passed through the GSU. The enhanced GSU can override the signal from the client machine, replacing it with its own video signal, which is automatically synchronized with the GSU clock. As indicated at Block A in FIG. 4D2, there are no steps required by the client machine to achieve this synchronization.

Details Relating The Operation Specified In Block D In FIG. 4 Without Using The GSU Of The Present Invention

In FIG. 4D, the suboperations are shown for carrying out the method of characterizing the client machine local clock and synchronizing the client machine display update cycle indicated at Block D in FIG. 4, for a system that does not utilize a global synchronization unit.

As indicated at Block A in FIG. 4D3, the local clock is "characterized". This process of characterization can be understood as follows. Given an abstract idealized "universal clock time", t , a local clock $t_l = f(t)$ (e.g. the system timer, real time clock, or for greater precision, the CPU clock cycle counter), and a global clock $t_g = g(t)$ maintained on the primary server, the local clock is said to be "characterized" when it is expressed as a function of the global clock value, $t_l = f(g^{-1}(t_g))$. Characterization of the local clock with respect to the global clock will be defined as determining some function $h(x) = f(g^{-1}(x))$. Over reasonable time periods, and assuming fairly high quality timing hardware, h(x) will be well

approximated by a linear function. The simplest method of determining this function is to use standard curve-fitting techniques. If the global clock on the primary server 100 is a GPS-based time reference, the local clock may be characterized very precisely by also using a GPS reference in the client machine. The GPS hardware can easily produce an extremely accurate and stable 1 Hz signal. This signal is connected to one of the CPU IRQ lines. This causes the CPU to enter an interrupt service routine every second. At the instant the interrupt is triggered, the CPU can record the reading of the local clock (CPU cycle counter register). After collecting a number of such samples, the function h(x) may be approximated to a high degree of accuracy.

The statistical information collected in order to determine the clock characterization function is appended to the security verification log.

As indicated at Block B in FIG. 4D3, after determining h(x), the client machine then uses this function to calculate the local clock time (t_{sl}) corresponding to the desired global clock start-time (t_{sg}) for the contest.

Next the video display update cycle is measured using the local clock. Almost every video display adapter used in personal computers has a set of registers used to control and monitor the scanning and refresh periods and rates. One standard function is the ability to query the adapter to determine whether it is currently in a vertical retrace period or not. By using this function over a period of time, and recording the local clock time each time the display enters vertical retrace, the period and phase of the display update cycle is determined with respect to local clock time. By reading the display adapter registers, it is simple to determine the difference between the time the last line of the displayed image is drawn and the beginning of the next vertical retrace. The instant that the last line of the display is drawn in any display update period will be referred to as the display time (t_d). Using this calculated period and phase the display times are extrapolated forward in time to find the display time closest to the desired start-time.

As indicated at Block C in FIG. 4D3, the client machine calculates the error (E_d) between the desired local clock start-time (t_{sl}) and the closet display update cycle (i.e. display time (t_d)). Throughout this process, the times associated with each vertical retrace are appended to the security verification log.

Since it is desired to have the client machine display the query simultaneously on all client machines, the error term E_d is minimized by shifting the phase of the display update cycle. A value of 0 for E_d indicates that the display will complete drawing the given image at the precise moment of the start-time. The phase of the display update cycle is adjusted by increasing or decreasing the display update period over a number of update cycles. This

period is typically determined by several registers on the display adapter, controlling the so-called "vertical total", "horizontal total", and the "dot clock". The vertical total is the total count of lines, both displayed and non-displayed (within the vertical blanking and retrace period), that make up one display update cycle. Similarly, the horizontal total measures the number of pixels, both displayed and within the horizontal blanking and retrace period. The dot clock frequency determines the number of pixels per second rendered to the display. By adjusting any one of these three values temporarily, the period of the display update cycle may be changed, again temporarily. Although it might be possible to align t_d with t_{sl} within a single update cycle, it is probably not desirable to make such a large modification to the display update period, since this can cause monitor clicking and may temporarily disrupt the displayed image. Instead, the display update period is modified only slightly (perhaps adjusting the vertical total by one or two lines), and the period is left adjusted until enough phase shift accumulates to reduce E_d to near zero, at which time the display update period is restored to its original value. This alignment of the display update cycle with the desired start-time satisfies the criteria set forth at Block D in FIG. 4D3.

Note that depending on the accuracy of the clocks, the frequency drift of the clocks and the refresh update cycle, and the distance into the future that the display time is extrapolated, it may be necessary to repeat the alignment procedure to reduce these errors. The display time alignment procedure should be considered an ongoing process, perhaps being performed concurrently with other steps in the contest process. As always, information about this process is recorded in the security verification log, providing a continuous trace of the operations taking place and the timing of those operations.

Details Relating The Operation Specified In Block E In FIG. 4 When Using The Basic GSU Of The Present Invention

In FIG. 4E1, the suboperations are shown for carrying out the method of presenting the query to the contestant at the contest start-time indicated at Block E in FIG. 4, for a system that utilizes a basic GSU 175. At this point, the encrypted query and start time has been stored on the client machine, and the display time has been aligned with the desired start-time.

As indicated at Block A in FIG. 4E1, the client machine uploads the encrypted query and start time to the GSU 175.

As indicated at Block B in FIG. 4E1, a short time prior to the desired start-time, the GSU 175 decrypts the query. This query is then downloaded to the client machine.

As indicated at Block C in FIG. 4E1, the query is then rendered to an off-screen memory area in preparation for display on the screen.

As indicated at Block D in FIG. 4E1,during the vertical retrace period that is one cycle before the display time, the off-screen image is flipped to the display, using hardware page-flipping techniques, or by blitting the image to the screen during the retrace period.

As indicated at Block E in FIG. 4E1, with the query image now residing in the currently displayed video memory, the client machine display draws the query onto the screen, reaching the bottom of the display at the start-time for the contest.

Finally, the client machine records the local time at the moment the vertical retrace begins, which should be simultaneous with the desired start-time. This time is also stored in the security verification log.

After the image is displayed, the client machine is primarily waiting for the contestant to enter their answer or response to the query that was presented. However, during this time, the client machine is not idle, but rather continues to monitor the various clocks and timing systems on the client machine (e.g. system timer, real time clock, CPU cycle counter, vertical retrace signal, etc). Information about the clocks is stored in the security verification log.

Details Relating The Operation Specified In Block E In FIG. 4 When Using The Enhanced GSU Of The Present Invention

In FIG. 4E2, the suboperations are shown for carrying out the method for presenting the query to the contestant at the contest start-time indicated at Block E in FIG. 4, for a system that utilizes an enhanced GSU 177. At this point, the encrypted query and start time has been stored on the client machine.

As indicated at Block A in FIG. 4E1, the client machine uploads the encrypted query and start time to the GSU 177.

As indicated at Block B in FIG. 4E2, the GSU decrypts the query immediately prior to the desired start-time. The query is then rendered by the GSU into its own display memory.

As indicated at Block C in FIG. 4E2, the GSU overrides the display, using its own synchronized refresh rate, and presents the query precisely at the desired start-time.

Details Relating The Operation Specified In Block E In FIG. 4 When Not Using The GSU Of The Present Invention

In FIG. 4E3, the suboperations are shown for carrying out the method of presenting the query to the contestant at the contest start-time indicated at

Block E in FIG. 4, for a system that does not utilize a global synchronization unit. At this point, the encrypted query has been stored on the client machine, the start-time is known in terms of the local clock, and the display time has been aligned with the desired start-time.

As indicated at Block A in FIG. 4E3, the game server transmits the query decryption key to the client machine. This query description key is shown as Message 485 in FIG. 3E. The timing of this message is important, since it must be sent early enough to allow the client machine time to decrypt and display the message before the desired start-time. On the other hand, if the query decryption key is sent too early, it compromises the security of the system since an unscrupulous user could use the key to decrypt the query and view it ahead of the start-time, thereby gaining an advantage over other users. Extensive testing will be used to determine the best timing for this message.

As indicated at Block B in FIG. 4E3, the client machine decrypts the query upon receipt of the query decryption key. In addition, the local clock time of the receipt of the query decryption key is recorded in the security verification log.

As indicated at Block C in FIG. 4E3, the query is then rendered to an off-screen memory area, in preparation for display on the screen.

As indicated at Block D in FIG. 4E, during the vertical retrace period that is one cycle before the display time, the off-screen image is flipped to the display, using hardware page-flipping techniques, or by blitting (i.e. copying) the image to the screen during the retrace period.

As indicated at Block E in FIG. 4E3, with the query image now residing in the currently displayed video memory, the client machine display draws the query onto the screen, reaching the bottom of the display at the start-time for the contest. Finally, the client machine records the local time at the moment the vertical retrace begins, which should be simultaneous with the desired start-time. This time is also stored in the security verification log.

After the image is displayed, the client machine is primarily waiting for the contestant to enter their answer or response to the query that was presented. However, during this time, the client machine is not idle, but rather continues to monitor the various clocks and timing system on the computer (system timer, real time clock, CPU cycle counter, vertical retrace signal, etc). Information about the clocks is stored in the security verification log.

<u>Details Relating The Operation Specified In Block F In FIG. 4 When Using The Basic GSU Of The Present Invention</u>

In FIG. 4F, the suboperations are shown for carrying out the method of submitting a time-stamped contestant response to a previously presented query indicated at Block F in FIG. 4, for a system that utilizes a basic GSU 175.

As indicated at Block A in FIG. 4F1, the response is entered into the client machine using any of several different methods depending on the specific contest being administered. For example, the response could consist of a single letter typed on the keyboard, a mouse click, a typed in sentence, a recorded audio segment, or other input. For timing purposes, however, it is necessary for the client machine to have a clear indication of the instant that the contestant submits this response. The response submission is typically indicated by either a mouse click at a certain location, or by a certain keypress (the <enter> key for example).

As indicated at Block B in FIG. 4F, the response submission and response is immediately sent to the GSU, which generates digitally signed time and space stamp for the response. This time and space stamp is appended to the security verification log.

As indicated at Block C in FIG. 4F1, the time and space-stamp is sent from the client machine 160 to the game server 150.

As indicated at Block D in FIG. 4F1, the game server 150 requests the actual (i.e. full) response from the client machine by sending a response request message, indicated as Message 495 in FIG. 3E. In many cases, if the response time contained within the Response Notification Message disqualifies the contestant from any chance at winning, then it will not be necessary to request the complete response, thereby greatly reducing the bandwidth requirements for this phase of the contest.

As indicated at Block E in FIG. F, if requested, the client machine encrypts the response, the response time-stamp, and a hash-value of the security verification log in order to create a message, indicated as Message 500 in FIG. 3E.

As indicated at Block F in FIG. 4F1, Message 500 is then sent to the game server 150 and the security verification log is closed and write-protected.

Details Relating The Operation Specified In Block F In FIG. 4 When Using The Enhanced GSU Of The Present Invention

In FIG. 4F2, the suboperations are shown for carrying out the method of the contestant submitting a time-stamped response to the previously presented query indicated at Block F in FIG. 4, for a system that utilizes an enhanced global synchronization unit 177. With the enhanced GSU 177, the input device is connected directly to the GSU 177.

As indicated at Block A in FIG. 4F2, the contestant uses the input device to enters the response into the client machine 160 through the GSU passthrough connection.

As indicated at Block B in FIG. 4F2, the GSU 177 automatically generates a digitally signed time and space stamp for the response. This time and space-stamp is appended to the security verification log.

As indicated at Block C in FIG. 4F2D, the time and space stamp is from the client machine to the game server 150.

As indicated at Block D in FIG. 4F2, the game server 150 requests the actual response from the client machine 160 by sending a response request message, indicated as Message 495 in FIG. 3E. In many cases, if the response time constrained within the response notification message disqualifies the contestant from any chance at winning, it will not be necessary to request the complete response, thereby greatly reducing the bandwidth requirements for this phase of the contest.

As indicated in Block E in FIG. 4F2, if requested, the client machine encrypts the response, the response time-stamp, and a hash-value of the security verification log to create a message, indicated as Message 500 in FIG. 3E.

As indicated at Block F in FIG. 4F2, Message 500 is sent to the game server 150 and the security verification log is closed and write protected.

Details Relating The Operation Specified In Block F In FIG. 4 When Not Using The GSU Of The Present Invention

In FIG. 4F, the suboperations are shown for carrying out the method of contestant submitting a time-stamped response to the previously presented query indicated at Block F in FIG. 4, for a system that does not utilize a global synchronization unit (GSU).

As indicated at Block A in FIG. 4F3, the contestant enters a response into the client machine using any of several different methods depending on the specific contest being administered. The response submission is detected by a customized low-level device driver, preferably by "hooking" an interrupt caused by the device.

As indicated at Block B in FIG. 4F3, the interrupt handler in the client machine records the local time "time-stamp" corresponding to the moment the response was submitted. This local time is appended to the security verification log.

Immediately upon receipt of the response submission, after recording the time-stamp, the client machine calculate a hash or CRC (cyclic redundancy

check) value using the contestant's response and the time-stamp. The hash value is appended to the security verification log.

As indicated at Block C in FIG. 4F3, a message containing the hash value and the response time, indicated as Message 490 in FIG. 3E, is immediately sent from the client machine 160 to the game server 150. This "response notification hash" Message is particularly useful when large responses, such as those generated from a microphone, are obtained, since the tiny packet-size will be less subject to a delay due to the bandwidth of the network. The time of receipt of the response notification hash by the game server 150 can serve as an estimate of the actual response time for later security verification.

As indicated at Block D in FIG. 4F3, the game server 1750 requests the actual (i.e. full) response from the client machine by sending a response request message, indicated as Message 495 in FIG. 3E. In many cases, if the response time contained within the response notification Message disqualifies the contestant from any chance at winning, it will not be necessary to request the complete response, thereby greatly reducing the bandwidth requirements for this phase of the contest.

As indicated at Block E in FIG. 4F3, if requested, the client machine encrypts the response, the response time-stamp, and a hash-value of the security verification log to create a message, indicated as Message 500 in FIG. 3E.

As indicated at Block F in FIG. 4F3, Message 500 is then sent to the game server and the security verification log is closed and write protected.

Details Relating The Operation Specified In Block G In FIG. 4

In FIG. 4G, the suboperations are shown for carrying out the method of fairly judging the contest and determining the winners of that contest indicated at Block G in FIG. 4.

As indicated at Block A in FIG. 4G, as responses are received by each game server from its client machines, the responses are compared with the correct answers in database 140. Of those responses containing correct answers, the time-stamps are compared to rank the responses from fastest to slowest.

As indicated at Block B in FIG. 4G, the sorted preliminary results are then encrypted using the primary server's public key.

As indicated at Block C in FIG. 4G, the encrypted preliminary results (i.e. rankings), indicated as Message 505 in FIG. 3F, as sent from the game server 150 to the primary server 100.

As indicated at Block D in FIG. 4G, the encrypted preliminary results from each game server are decrypted by the primary server 100. Using an insertion

sort or other similar method, the pre-sorted preliminary rankings from the games servers are merged into a single sorted list of responses.

As indicated at Block E in FIG. 4G, from the presorted list, the primary server 100 calculates the overall ranking of the contestants and identifies the winner or winner(s) of the contest.

As indicated at Block F in FIG. 4G, for each winning response, the primary server 100 sends a security analysis request, indicated as Message 510 in FIG. 3F, to the game server that is connected to the corresponding client machine of the contestant who submitted that response.

As indicated at Block G in FIG. 4G, in response, each game server sends the security log, indicated as Message 515 in FIG. 3E, to the corresponding client machine.

As indicated at Block H in FIG. 4G, the client machine transmits to the game server, the security verification log, indicated as Message 520 in FIG. 3E, encrypted using the game server's public key.

As indicated at Block I in FIG. 4G, the game server decrypts and verifies the integrity of the security verification log using the hash-value of the security verification log.

As indicated at Block J in FIG. 4G, the game server uses the content of the security verification log to attempt to detect fraudulent activities. The response notification hash is used to make sure the response sent is consistent with the response entered at the response notification time. In addition, all of the various timing measurements can be analyzed for consistency and compared to the corresponding transmission and receipt times of messages by the game server.

As indicated at Block K in FIG. 4G, the game server compiles the results from all the requested security logs for its client machines and transmits this message, indicated as Message 525 in FIG. 3F, to the primary server 100.

As indicated at Block L in FIG. 4G, upon receiving the compiled results from all the game servers, the primary server either accepts, rejects, or flags the winning responses for further analysis by other means.

As indicated at Block M of FIG. 4G, a revised list of winners is created by the primary server based on these changes.

As indicated at Block N in FIG. 4G, this revised list is encrypted using the game server's public key and the resulting message, indicated as Message 530 in FIG. 3F, is sent back to the game server 150.

As indicated at Block O in FIG. 4G, each game server in turn transmits the contest results, indicated as Message 535 in FIG. 3E, to each of the client machines 160.

As indicated at Block P of FIG. 4G, a message containing the contest results, indicated as Message 540 in FIG. 3G, is sent from the primary server 100 to the web server 110 for posting on the contest web site.

Alternative Embodiments Of The System And Method Of The Present Invention Using Network Clock Synchronization

In the illustrative embodiment of the system of the present invention described above, a global time reference is accessed (by each of the client machines) through the use of global positioning system (GPS) receivers located in both the client machines (within the GSUs) as well as in the primary server 100. The GPS system receives time signals from GPS satellites 180 which, in turn, receive their time signals from an atomic clock. The GPS receivers offer the most precisely synchronized time signal available for use in a distributed system of this type.

However, in particular applications, it may not be economically feasible to equip every client machine with a GSU. In such cases, an alternative method of distributing the master clock time to the clients must be used when characterizing the local clocks on the client machines or when synchronizing the client machine display update cycle.

A solution to this problem is to transmit the master clock time signals from the primary server 100, over the network 190, to the client machines 160. There is a standard method for distributing time signals over the Internet which is embodied in the network time protocol well known in the art. The network time protocol, or NTP, compensates for network latency when distributing the time signals by performing statistical analysis of the network latencies between the computers, and then taking that latency into account when transmitting the time from one machine to another. The techniques used in NTP can easily be adapted for use in characterizing the client machine's local clock, instead of using the GPS for that purpose. The characterized local clock can then be used for synchronizing the display and for causing the presentation of the query at the desired start-time. Although the generic NTP protocol could be used, in the case of the contest system security considerations dictate that additional encryption and other security measures be taken to minimize the chance of tampering with the system.

An alternative way of providing a much more accurate start-time than that achieved using the method proposed in US Patent 5,820,463, would be to use NTP to characterize the local clock, and then use that local clock to trigger display of a query results. This is because the prior art method of US Patent No. 5,820,463 bases the start-time on the timing and latency of a single message

containing the decryption key, while the improved method of the present invention bases its start-time on the local clock, which has been characterized using many repeated messages, thereby minimizing the effects of random fluctuations in individual message latencies. The preferred embodiment of the present invention incorporating GPS entirely eliminates the effects of (variable) network latency, by bypassing the Internet through the use of satellite transmissions, wherein the latencies caused by the distance to the satellite are automatically compensated for.

In summary, the system and method of the present invention described hereinabove include a number of measures to ensure the fairness of the contest and the security of the contest against dishonest contestants and malicious third parties. Encryption is used extensively for most messages passing between machines. Confidential message protocols, combined with encryption prevent hackers from intercepting and modifying messages, thereby disrupting the contest or giving an unfair advantage to any contestant. In addition, extensive logging of all aspects of the timing procedure allows post contest analysis to detect any inconsistencies that might indicate tampering. The client software can also generate self-checking. Cheating will be greatly discouraged by the knowledge that the contestant can be disqualified for any discrepancy in this log.

In addition, the system and method of the present invention can also verify that the original, unmodified client software is being executed during each competition. The system and method of the present invention may also use a challenge-response verification scheme, in which the game server sends a series of messages to the client machine software, and verifies whether the responses to those messages are as expected. The challenges and responses will include a variety of methods, varying over time, to prevent a hacker from recording the "correct" answers to queries. The responses could include pseudo-random numbers, generated using a method known by both the client and server, in which it is extremely difficult to predict the next number, or to reverse-engineer the algorithm used to generate those numbers. The challenge-response verification messages can be used at any point during the contest, for example during the time the system is waiting for a query, or waiting for a response from the contestant, or after the submission of the response.

An extremely motivated hacker might be able to circumvent some of the defenses presented above by completely disassembling the client software, thereby understanding the encryption and obscuration methods used. Therefore, the system and method of the present invention may also include another layer of security through the use of just-in-time downloaded code

fragments or through the use of encrypted code fragments with just-in-time downloaded decryption keys. In accordance with this method, crucial parts of the client software, particularly those used for secure communications (encryption and decryption), those used for clock manipulation and monitoring, and those used to perform self-checking on the program.

Clearly the embodiment that incorporates a GSU 175, and in particular the enhanced GSU 177 has much stronger security, since the encryption and decryption on the client machine may be performed entirely within the GSU hardware. Additionally, as time-stamping and query presentation timing are performed in hardware, many of the opportunities to trick the system are avoided. For the highest level of security, the GSU itself will be physically sealed with tamper-evident devices, and in the event of a large prize award, the GSU will be examined as part of the requirements when claiming the prize.

Remote Creation And Administration Of Contests Within The Contest-Promoting System Of The Present Invention

The contest-promoting system of FIG. 2 described hereinabove utilizes a "centralized" contest creation and administration subsystem, wherein the contest management interface software 260 located on the primary server 100 is used by the contest administrators to enter questions and answers into database 140, to design and specify contests, to schedule contests, and to monitor and control those contests.

In order to provide contest administrators greater flexibility in contest creation, management and execution, the contest-promoting system of FIG. 2 can be modified to further include additional components and processes depicted in FIGS. 6 through 6C which collectively enable contests to be created and administered from any number of remote administration consoles 600 located anywhere around the globe. This feature of the present invention has a number of important advantages. For example, remote contest creation and administration creates additional opportunities and potential business models. In particular, administration of tests and quizzes in educational settings is an ideal application for a remotely administered time-constrained contests (or tests) carried out using the contest-promoting system of the present invention. Often, teachers, professors, and other educators wish to control the content and format of the testing and evaluation tools they provide. Using the contest-promoting system shown in FIG. 10, the educator can easily set up a remote administration console 600, and then use that console to design, test, schedule, and administer a test to their students.

As shown in FIG. 10, the remotely-administered contest-promoting system of the present invention is similar to the centrally-administered contest-promoting system of FIG. 2 and therefore includes: the primary server 100; client machines 160; game server 150; login server 120; web server 110; contestant database 130; login server 120; and the network 190. In addition, as shown in FIG. 10A, the remotely administered contest-promoting system of the present invention further includes: the remote administration server 610; the remote administration consoles 600; and the contest database 660.

As shown in FIG. 10B, the remote administration console 600 is a general purpose personal computer (PC) utilizing standard components such as, for example: the operating system 240; device drivers 280; network interface 215; standard I/O hardware 220; and clock and timer hardware 290. In addition, remote administration console 600 is provided with several software applications, such as a web browser 320, a remote administration plug-in 640, and a remote administration client application 650. The remote administration software, consisting of the remote administration plug-in 640 and the remote administration client 650, is downloaded and installed following a procedure similar to that used to obtain the contest client software for the client machines. Users must register on a web site to obtain authorization to administer contests using the system. This procedure follows an outline similar to that presented in FIG. 4A. However, in this case, the web site accessed is the remote administration web site served by the remote administration server 610.

The remote administration client software 650 is an application or group of applications which perform a number of different tasks, including designing and entering queries and answers, testing the contest, scheduling contest times, identifying those contestants eligible to participate in the contest, and submitting the completed contest to the remote administration server. The remote administration plug-in 640, in conjunction with the web browser 320, may be used to monitor the contest and to view and download contest results.

As shown in FIG. 10C, the remote administration server 610 is a high performance server using a standard operating system 240, device drivers 230, standard I/O hardware 220, and a high performance network interface 210. On this system, two primary applications are run, namely: the remote administration web server 620; and the remote administration daemon 630. The remote administration web server 620 supports the contest management web site, which provides information to users wanting to create and manage their own contests or tests. The remote administration daemon 630 communicates with the remote administration clients 650 running on an arbitrary number of remote administration consoles 600. The remote administration daemon 630

collects information about requested contests and their schedules. Information about the scheduling, participants, and references to questions and answers are stored in the contest database 660, for later use by the primary server 100. The remote administration server also accesses the contestant database 130 to verify contestants and record performance data about the contestant or test taker. The actual queries and answers are stored in the query/answer database 140. Virtual network connections between the remote administration components are shown in FIG. 10A.

Live Television Broadcasting Of Contests For The Enjoyment Of Spectators Supported By The System Of The Present Invention

In virtually every contest, sport and public entertainment event, there is some form of product and/or service advertising aimed at the spectators, and not the contestants. Thus, from an economic standpoint, the contest-promoting system of the present invention also includes several provisions which allow as many spectators as possible to view the contest and its associated advertising. Although the Internet is growing at an amazing pace, the number of participants is still small compared to the vast numbers of people who own television sets and regularly view television. In order to reach this additional audience, the contest-promoting system of the present invention is particularly adapted to enable spectators to view television broadcasts of Internet-based contests enabled by the system hereof.

As shown in FIG. 11, the contest-promoting system of the present invention depicted in FIGS. 2 through 4G and 6 through 6C, also comprises a number of system components which are configured so that live video, taped video program content, and real-time information and results can be combined and distributed "on the fly" to spectators viewing one or more contests on standard television sets throughout the world. As shown in FIG. 11, these additional system components include: the web server 110; video-enabled client machines 900, web-to-video processor 910, real-time video compositor 920; taped video content playback unit 960; live video sources (e.g. cameras) 950; broadcasting equipment 930; and television viewers 940.

In order to enhance and dramatize the contest for the viewers, live video images are captured by each video-enabled client machine 900. In general, each video-enabled client machine 900 is equivalent to a client machine 160 with the addition of a video camera and associated video compression and transmission software. The video camera and software is readily available as part of commercially available video conferencing systems well known in the art.

In addition to delivering video images of the contestants, the system also allows both live video 950 and taped video content 960 to be incorporated into the complete video broadcast. This content could include advertising, information related to the contest, as well as a live MC or host for the contest.

The function of the web-to-video processor 910 is to filter, format and render (i) data generated by the primary server 100 and distributed through the web servers 110, and (ii) data transmitted by the video-enabled client machine 900. The contest creators or administrators can create a specially designed "web-page" containing all of the information to be shown in the live broadcast. This page can include dynamic elements such as Java™ or ActiveX™ components so as to continually update and refresh queries, answers, scores, contestant information, and other data. The web-to-video processor 910 is provided with an HTML (or XML) rendering engine along with a Java virtual machine (JVM) and other dynamic web technologies.

As shown in FIG. 11, video streams from the live video camera 950, taped video playback unit 960, and from the web-to-video processor 910 are combined and laid out by the real-time video compositor 920, resulting in a single unified view depicting the various aspects of the contest currently in progress. FIG. 11A shows just one possible video display layout for a contest between two teams of three people, wherein live video is displayed in the top-center of the display screen, and the formatted output of the web server 100 is displayed along the bottom of the display screen.

During the operation of the contest, the real-time video compositor 920 sends the final video signal to standard broadcasting equipment 930, which transmits the video signal to the spectators television sets 940 via cable, satellite, and/or radio waves.

Contest-Promoting System Of The Present Invention Employing Television-Based Client Machines

The system components shown in Figs. 7 and 7A and described hereinabove enable spectators to passively observe Internet-based contests while viewing conventional televisions sets 940. In an alternative embodiment of the present invention depicted in FIG. 12, additional system components are provided to enable contestants to actively participate in the contest through a television-based client machine. As shown in FIGS. 8 and 8A, a television-based client machine 970 in accordance with the present invention comprises the following the components: a set-top client machine 970; a IR-based remote-control input device 980; and a standard television set 990. As shown, the set-top client machine 970 is connected to the user's television set 990 using a

standard NTSC or PAL cable. In addition, the set top client machine 970 has connections to an antenna or cable, as well as to the Internet using a modem 976 over a telephone line to an internet service provider.

The set-top client machine 970 receives and processes contest data, including queries through both the modem as well as through the incoming video signal. The video signal will contain live video in standard format, and could optionally contain additional data broadcast during the vertical blanking interval, perhaps using the Intercast™ format.

As shown in FIG. 12A, the set-top client machine 970 comprises a number of major components, namely: a GSU 175 or enhanced GSU 17;, clock and timer hardware 290; a television tuner with Intercast™ decoding capability 977; a modem 976; an infrared input port 975; NTSC or PAL audio/video output 974; embedded device drivers 973; and embedded operating system with Java capability 972 running on a microprocessor, and a firmware contest client 971. Like the computer-based client machine 160, the set-top client machine 970 uses the GPS receiver in the GSU to discipline the local clock of the client machine. This clock is used to trigger the display of queries on the television screen, as well as to measure the elapsed time taken by the user when answering queries (or submitting responses to ITRs).

The television-based client machine 970 has a number of advantages over the computer-based client machine 160. First, the bandwidth requirements on the modem Internet connection are greatly reduced since much of the content is delivered through the television signal. Second, the set-top client machine 970 can be made much more inexpensively as compared to a general purpose computer. For the end-user, the set-top box 970 could be even provided at a reduced fee or even for no cost by their cable television provider, since the set-top box also functions as a tuner. An additional advantage with the set-top configuration is the ease of making the system secure. Unlike a general purpose computer, programming and development tools and interfaces would be proprietary, limiting the ability of hackers to develop programs to compromise the system. Also, programs would be stored in tamper-resistant EPROM, making it almost impossible for a hacker to disassemble the program to learn its vulnerabilities.

One disadvantage to the set-top based version is the difficulty in achieving microsecond accuracy synchronization. Normally in a television system, the display refresh timing is determined by the incoming NTSC or PAL signal. In order to precisely synchronize the refresh rate would require at least one frame of video memory storage, which would be used to buffer the incoming data. Most likely only one frame of storage would be needed, since the television

signal will be fairly well synchronized due to the real-time nature of television broadcast, in contrast to the packed-based, store-and-forward architecture of the internet.

Alternative Applications For The GSU Of The Present Invention

The global synchronization unit (GSU) of the present invention clearly has important capabilities and numerous applications beyond those relating to online contests and games, financial and commodity trading operations, on-line real-time auctions, and other forms of time-constrained competition over the Internet. As discussed above, the GSU, enables a number of functions that transcend those provided by a standard clock or even a GPS device. These functions fall into three basic categories: time and space synchronized generation of output events; time and space stamping of input events; and verification of previously generated time and space stamps.

The first category of functionality is the generation of output events in response to specific time and space conditions. The GSU core processor 750 can receive instructions, through a local user interface or through an interconnection to another device or computer, that set up time and space constraints along with associated actions that are to be performed when the time and space constraints are satisfied. In the case of the contest application, the constraint was to perform the action at the instant of the desired start-time. The action performed in this case was the decryption and display of the contest query. The GSU 175 can be programmed to generate an number of different output actions in response to the time-space conditions. However, using the security and encryption capabilities of the GSU, the nature of these actions may be concealed until the action is actually performed. Applications for this capability could range from the serious, for example the secure delivery of sensitive messages or data that may only be revealed at a certain time or location; to the frivolous, such as a scavenger hunt game in which additional clues are revealed by the GSU as the player reaches each sub-goal location.

The second category of functionality is the creation of time and space stamps which record and authenticate input events. The GSU core processor is commanded, again either through a local operator interface or through a connection to another device or computer to generate a time and space stamp. This stamp may or may not be associated with additional input device data. When associated with additional input data, the GSU encryption capabilities can be used to generate a digital signature on the combined time, location, and input data. This digital signature can later be used to verify that the data did indeed

exist at that time and location, and that the data has not been altered since that time. Of course, this method cannot be used to verify whether or not the data existed before the specified time, or whether the data existed in other locations, but it does establish an upper-bound on the creation time, and prove that the data was available at a particular location.

The final major capability of the GSU hardware is the ability to authenticate and verify digitally signed time and space stamps that it has created in the past. Depending on the specifics of the digital signature and time and space-stamping methods used, it may also be possible to verify time and space stamps using other GSU's or other hardware or software systems. In essence, the GSU can serve as both a notary as well as a witness to claims about the timing and location of events.

FIG. 13 shows just a few of the potential inputs to a GSU (175 or 177) that might benefit from its time and space stamping capabilities. These inputs range from those with very specific purposes, such as water level sensors, burglar alarms, and police radar, to very general purpose inputs with a wide range of applications, such as still image and video cameras, microphones, and chemical "sniffers". Other possible inputs include: bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, optical sensors for race finish lines, temperature sensors, and signature capture devices. The applications for a GSU having these inputs are virtually limitless, and the input devices shown are only a representative sample of the possible inputs.

FIG. 14 shows examples of devices into which GSU components of the present invention can be embodied and provide beneficial results .

A Web-enabled handheld computer with an embedded GSU, and possibly wireless Internet access, could be carried by a delivery person for time and space stamping package deliveries. By attaching a digital still camera to the input of the GSU, an image of the person receiving the package could be taken and incorporated into the record of the transaction. The time and space stamp placed on the captured image would be digitally signed by the GSU to allow verification of the image at a later time. GSU equipped digital cameras, along with tamper-resistant and tamper-evident mechanical seals could be used to provide legal documentation of any number of transactions or events. Employees of insurance companies could utilize such devices to document accident damage. Similarly, bar-code scanners, document scanners, and police radar units could all be equipped with GSU's to provide enhanced security and authenticity.

As shown in FIG. 15, the basic GSU unit 175 and enhanced GSU 177 can be built in a number of different configurations for use as peripheral devices to

general purpose personal or business computers. These devices could connect to the client computer using PCMCIA slots, ISA/PCI or SCSI interfaces, or through serial or parallel port connections. Alternatively, GSUs 175 and 177 can also be realized as single Application Specific Integrated Circuit (ASIC) devices, wherein analog and digital circuits are embodied in a manner known in the ASIC chip manufacturing art.

Globally Time-Synchronized Securities/Commodities/Currency Price-Quotation And Trading System Of The Present Invention

As described hereinabove, the present invention enables simultaneous presentation of data to multiple users connected over a network to a central computer or computers. Additionally, the present invention also enables secure and precise calculation of time and space stamps for events that occur at a client machine. These stamps are digitally signed so that they may be authenticated and to make them resistant to forgery. Based on these inventive features, the present invention can be applied to the buying and selling of financial securities, commodities, and other items of value over the Internet, including articles and goods being auctioned off at on-line auction sites on the WWW.

In particular, the present invention can provide traders (persons involved in the buying and selling of financial securities or otherwise profiting from the fluctuation in prices of those securities) with the ability to conduct financial trades in a manner that provides greater fairness and security than those currently afforded them.

One important aspect of securities trading is the ability to view and monitor price quotes for securities and to view and monitor information about trades and other transactions involving those securities. Typically, traders subscribe to a service that provides price quotes for offers to buy and sell securities. Depending on the level of service they have purchased, the quotes will be delivered with some predetermined delay (ranging from "real-time" to twenty minutes or so). Prior art real-time trading or auctioning systems do not compensate for network latency when producing these delayed quotes or bids, and therefore the trader (or bidder) will actually receive them some random amount time after the specified delay. Using similar components, protocols, and procedures as provided for the contest-based system described above, the principles of the present invention can be applied in order to produce a competition-promoting system which enables the simultaneous display of price quotes (as well as bids) to millions of competitors world over, for any given

delay so as long as the specified delay is greater than the worst case latency expected for the client machines of these competitors.

In addition, the Internet-based competition-promoting system of the present invention can also enable secure time and space-stamping of client machine-based activities such as the submission of offers to buy or sell securities, options or the like, as well as bids to buy goods being auctioned off at on-line auction sites. When using the hardware-based GSU hereof, each client machine in the system is enabled to generate a digitally-signed time and space stamp for each transaction, thereby allowing the client's transactions to be processed (i.e. executed and cleared) in a secure and fundamentally fair manner.

As shown in FIG. 5, the financial securities/commodities price-quotation/trading system of the illustrative embodiment comprises a number of subcomponents, namely: a primary server 100; one or more web servers 110; a login server 120; a trader database 35; a real-time market state server 45; one or more real-time price-quotation and trading servers 55; and a plurality of client machines 160. In many respects, the system of FIG. 5 is similar to the system of FIG. 2, except that certain components are modified appropriately to the nature of securities, commodities or currency market(s) involved. Like reference numerals indicate like components in the systems.

Overall operation of the price-quotation/trading system is controlled and directed by a computer or set of computers or devices that will be referred to collectively as the primary server 100. The primary server provides certain functionality to the system, communicating with the real-time market state server 45, distributing quote and other market data to the real-time price-quotation and trading servers 55, providing a master clock for the system, and collecting and performing preliminary processing on quotation and trade requests.

The primary server 100 is substantially similar to that provided for the contest-based embodiment of the invention, shown in FIG. 2G. However, the contest management interface 260 will be replaced by a financial securities trading management interface, with functionality appropriate to this application, such as the ability to assign certain rights to traders, to change trader quote delays, and other such activities.

The single primary server 100 communicates indirectly with the client machines through a number of real-time price-quotation and trading servers 55. These servers relay quotes and other financial data to the client machines 160, and receive trade requests from those client machines. Preliminary verification and sorting of the trades is performed by the real-time price-quotation and trading servers 55, and these pre-processed results are then passed back to the

primary server 100. The hardware and software architecture of the real-time price-quotation and trading servers 55 are similar to the game servers 150 depicted in FIG. 2E. This figure shows a layered architecture similar to the primary server 100, with hardware components including a GPS receiver 170, high precision timing hardware 200, and a high performance network interface 210 in addition to the standard hardware components 220. These hardware components are controlled through the use of a set of standard and customized device drivers 230. Many of these device drivers are provided by the hardware manufacturers, while some are specifically written or modified to handle the precise timing operations needed by the financial trading system. The major application running on the real-time price-quotation and trading servers is the financial trading system daemon. This software receives, processes and responds to data from the primary server, the login server, and from its client machines.

The trader interacts with the system through a client machine 160. Each trader uses a single client machine to receive and view security prices and other financial data as well as to enter and transmit requests (i.e. orders or offers) to buy or sell securities or options. Each client machine 160 consists of a standard personal computer, augmented by the addition of several software and hardware components. The critical hardware component on the trader's client machine is the global synchronization unit (GSU) 175. The GSU decrypts and displays quotes precisely at the specified delay, and also time and space stamps the trader's requests (i.e. orders) to buy and sell securities, options or the like. These time and space stamps are digitally signed to provide a secure record of the requested transaction.

When not actually performing trades, the trader interacts with a financial information providing web site through a web browser. The contest web site is "served" to that browser from one or more web servers 110. The web servers handle advertising, support, registration, downloading, and other similar tasks.

Another key component of the price-quotation/trading system shown in FIG. 5 is the login server 120. The login server accepts login requests from the trader's client machines and assigns an appropriate real-time price-quotation and trading server to that client machine. The login server provides a single, well-known address for the client machines to contact when initializing a new trading session. The login server also serves to intelligently distribute the processing and communications load among the real-time price-quotation and trading servers. FIG. 5B shows the virtual network connections between the login-server and the trader's client machines.

FIG. 5 also depicts a trader database 35. The trader database records information about the users, such as their identity, preferences, contact information, and a history of past transactions.

The real-time market state server 45 acts as the interface between the trading system of the current invention and the actual stock-exchange (or commodity-exchange or currency-exchange) computers that provide the price quotes and process orders to trade (e.g. execute orders by matching offers to buy with offers to sell). This server 45 collects requested information and translates them into the proper form for transmission to the primary server 100. In addition, the real-time market state server 45 accepts client time-stamped trade requests (i.e. orders to buy and sell) from the primary server 45, reformats them into the proper protocols, and transmits them to the appropriate stock-exchange (or commodity-exchange or currency-exchange) computers. Finally, the results of the trades are collected and sent back to the primary server 100 for distribution to the client machines through the real-time price-quotation and trading servers 55. By carrying out accurate time-stamping at both the client and server ends of the trading process, each order to trade (i.e. buy or sell) carries two time-stamps (i.e. one produced at the client machine and one at the server) and therefore can be reliably accepted and executed based upon the submission-time of the order at the client machine and not upon the receipt-time thereof at the server. Consequently, this enables, in theory and practice, order execution subsystems to execute orders for trade based on the time of order placement at the client machine, and not when they are received at the server, or when they are delivered to the order execution subsystem at some later time.

Moreover, the client machine placing an order for a trade (i.e. message) will receive a receipt of the time-stamp of when the order to trade was actually received at the server. Also, time stamping of orders to trade at the server (e.g. maintained in a stock brokerage house) could also prohibit or dissuade stock brokerages from delaying the transmission of such order messages to order execution subsystems (e.g. electronic communication networks ECNs) over which orders to buy a particular security are matched with orders to sell the particular security, as oftentimes occurs when a market begins to lose value and the stock brokerage firm will try to sell off or buy positions on its own account, before executing the orders for trade of its customers/clients.

As with the other preferred embodiments, the components of FIG. 5 are interconnected through the Internet or other network, as indicated by network 190.

Notably, the general operations depicted in FIG. 4 and carried out by the system of FIG. 2 are also carried out by the price-quotation/trading system of FIG. 5, with various modifications of course to accommodate the different application at hand. Collectively, these operations enable a competitor (i.e. market participant or trader) to participate against millions of competitors, in a secure and fundamentally fair time-constrained competition to buy and sell limited economic resources in a generally "free" market, wherein prices are set by supply and demand forces, rather than by governmental fiat or regulation. By virtue of the present invention, each competitor, connected to the price-quotation/trading system by an on-line connection established by a client machine, receives updated price quotations at a common "start-time" regardless of the location of his or her client machine on the infrastructure of the Internet, or on the planet Earth. Thus, trader/competitors in Tokyo, Japan and New York, New York, will receive real-time price quotes on market activity at the same globally-synchronized time. Also, the GSU in each trader's client machine securely places a time and space stamp on each trader's trade, to ensure that such geographically distributed and differently Internet-connected traders are able to compete under fundamentally fair and network-secure conditions. Further, as the server ????????? By carrying out accurate time-stamping at both the client and server ends of the bidding process, the bid can be reliably accepted based upon the submission-time and not upon the receipt-time.

In the system of FIG. 5, the operation indicated at Block A in FIG. 4 would be modified so that each trader or competitor registers with the system as a trader, and downloads price-quotation/trading software to create a globally-synchronized and secure-networked client machine.

In the system of FIG. 5, the operation indicated at Block B in FIG. 4 would be modified so that each trader logs on to the price-quotation/trading server 55, and establishes a communication channel therewith.

In the system of FIG. 5, the operation indicated at Block C in FIG. 4 would be modified so that the system periodically transmits the price quotation updates and the start-time from the primary server 100 to each client machine 160.

In the system of FIG. 5, the operation indicated at Block D in FIG. 4 would be modified so that system characterizes the client machine's local clock with the master clock on the primary server 100, (i.e. if an enhanced GSU 177 is not provided), and the synchronization of the client machine display update cycle with the desired start-time for the price quotation update.

In the system of FIG. 5, the operation indicated at Block E in FIG. 4 would be modified so that the system presents the price quotation updates to each

trader precisely at the same globally-synchronized start-time, e.g. as determined by a local clock that is characterized with respect to a global master clock located on the primary server 100.

In the system of FIG. 5, the operation indicated at Block F in FIG. 4 would be modified so that the GSU-enabled client machine accepts the trader's response (e.g. offer/order to buy and/or sell a particular amount of stock, commodity or currency for a particular price), attaches a time and space stamp to that response, and transmits the response and time stamp to the servers 55 in the system.

In the system of FIG. 5, the operation indicated at Block G in FIG. 4, would be modified so that the real-time market state server 45 receives information regarding the orders during the past price-quote/trade cycle, and thus updates the same.

During the next subsequent price-quotation display time (i.e. next start-time) in the market competition, updated price quotations are simultaneously displayed/presented to each of the on-line traders in a globally time-synchronized manner. In response thereto, each trader can respond to such changing market conditions by placing trade orders which are time and space stamped at the originating client machine, in a globally time-synchronized manner. By virtue of the system of the present invention, such orders are fairly and securely executed (i.e. matched with corresponding unfilled orders in the marketplace) in accordance with conventional time-prioritized procedures and practices of the market.

A system similar to that described above can be constructed and deployed in order to improve the operation of on-line real-time auctions in fundamentally fair and secure manner, thus eliminating any advantages held by those bidders having faster computers and/or Internet connections.

On-Line Auction System And Method Of The Present Invention

Referring to FIGS. 6 through 9E, an on-line auction-supporting system and method will now be described in accordance with the principles of the present invention.

In this particular embodiment of the present invention, the primary goal of the Internet-based system and method is to enable thousands and even millions of bidders to participate in a multi-bidder, time-sensitive, internetworked real-time auction that is regulated in a secure and fundamentally fair manner. In general, the auction will involve a large population of bidders who simultaneously attempt to bid on some article of merchandise, commerce,

antique, or other good put up on the "auction block" in a time-constrained manner.

In general, the auction consists of a large number of bidders attempting to bid upon an item of merchandise that has been offered for sale. Each bidder in the auction will interface with the auction through a client machine 160. The client machine displays images, text, video, plays audio, or uses other means to present auction information for the item of merchandise that is being offered for sale. The client machine also accepts bids from the bidder based upon the information previously presented. Therefore, the client machine is a device that presents auction information and accepts bids from one bidder who is participating in the auction.

The auction-supporting system has the capacity to control and measure certain time-based elements of the auction. These elements include: the ability to specify the precise instant at which the auction will start and the bidders will be allowed to submit bids, referred to as the "start-time"; the ability to specify the precise instant at which a bid is submitted, referred to as the submission-time; the ability to specify the precise instant at which the server receives the bid, referred to as the "reception-time". In addition, the system is capable of precisely determining the length of time between the submission-time and the reception-time. referred to as the "response-time".

In accordance with the principles of the present invention, the system ensures that the submission-time of each bid is accurately time-stamped at the client machine and the reception-time of each bid is accurately time-stamped at primary server 100'. The system contemplates that the network latency, as measured by the response-time, may vary based on a number of factors including, for example: client machine hardware, network connectivity, traffic on the network and others. By carrying out accurate time-stamping at both the client and server ends of the bidding process, the bid can be reliably accepted based upon the submission-time and not upon the receipt-time. Thus the system and method of the present invention compensates for (i.e. levels out) any differences between network latencies of competing bidders and ensures that no one is disadvantaged based upon the response-time of their client machine used during the auction process. Also, each client machine configured in the system of the present invention receives verification of the receipt of the bid, wherein the verified receipt contains both the submission-time and reception-time. If the GSU-enabled client machine does not receive a bid verification, it will automatically resubmit the bid. Notably, the measured response-times of the clients also provides a measure of the network latencies and allows the server to continue accepting bids after the "close of bidding" for a period of time greater

than the longest measured network latency. The submission-time of any bid received after the close of bidding is verified to ensure that the bid was submitted prior to the close of bidding.

In the preferred embodiment, the local clock associated with each client machine is characterized using a GPS receiver installed therein. GPS receivers can provide a clock reading as well as an extremely precise and accurate 1Hz signal. This signal is sampled and the local clock read repeatedly. By analyzing the relationship between the local clock and the 1Hz signal over time, the relationship between the two clocks can be determined using standard curve-fitting methods.

Preferably, each client machine is provided with GSU, including a GPS receiver module as described in detail hereinabove. However, in the absence of a GPS receiver module on the client machine, other techniques may be used to characterize the local clock on the client machine. In particular, the methods and algorithms based on the standard NTP (i.e. network time protocol) can be used. As discussed above, these algorithms are typically used to synchronize clocks over networks, and automatically measure and compensate for network latency. NTP could be used directly, or more likely would be modified to increase the accuracy.

The auction-supporting system of the present invention also employs extensive security measures to detect and discourage cheating by dishonest bidders. Security is crucial in large auctions involving significant items of value. Security for the system is provided by encrypting the majority of messages between the various computers in the system, as well as by monitoring and logging the auction-related activities on each client machine. Security is also provided by means of a unique identification for each client machine. The login for each bidder is associated with the unique identification selected from a limited number of client machines. This feature of the system ensures that only the registered bidder can place bids from a client machine and provides a method of determining if someone else is using a bidder's login. The security measures also include the ability to pre-quality bidders based upon their credit rating and available credit limit. This feature of the system will prevent bidders not capable of paying for an item, from bidding on it or bidding more than they are able to afford to pay, and ruining the auction process supported by the system.

In the preferred embodiment, encryption measures within the system are enabled by encryption hardware installed in the client machine. The benefit of the encryption hardware is the ability to quickly encrypt and decrypt messages to and from the server with which each client machine cooperates. In addition,

the encryption hardware can be encoded with the unique identification number. In the absence of encryption hardware, other techniques may be used to encrypt and decrypt messages between the clients and servers of the system. In particular, the methods and algorithms of the standard SSL (secure socket layer) can be used. These algorithms are typically used to encrypt and decrypt messages between a web browser and a web server over the Internet. In terms of the unique identification, an identification can be generated and stored on the client machine in encrypted form as an alternative.

The auction-supporting system of the present invention can duplicate the characteristics of a live auction unlike current online auctions. The present invention can also be used for auctions with set finish times like current online auctions, but with the added benefit of correcting for latency and confirming the receipt of bids. In addition, the present invention has the ability to pre-qualify bidders for financial capability.

In the preferred embodiment of the system, the encryption hardware and the GPS receiver are coupled together on a single ASIC in a tamper-resistant and temper-evident package, referred to as the GSU (i.e. global synchronization unit). The benefit of this design is the increased security that a single GSU will provide. The single ASIC is significantly more difficult to circumvent or reprogram because of the integrated design. In addition, the encryption capabilities of the GSU make it possible to control the updating of the software that runs on the unit itself and can prevent dishonest bidders from forging time-stamps or altering the unique identification.

In a more preferred embodiment of this system, the encryption hardware, GPS receiver and fractal antenna are integrated into a single ASIC in a tamper-resistant and tamper-evident package. The fractal antenna employs a recursive design, as well known in the antenna arts. In addition, the single ASIC design is intrinsically more resistant to attempts to circumvent the security features. Preferably, the GSU can be realized in numerous form factors including, for example, a computer mouse, a keyboard, and advertising product designs such as a Coke bottle, Pepsi can, or other well-known product forms.

Having provided an overview on the auction-supporting/promoting system of the present invention, it is appropriate to now describe in greater detail the structure and function of the components thereof.

As shown in FIG. 6, the auction-supporting system of the illustrative embodiment comprises an integration of components, namely: a primary server 100'; one or more web servers 110'; a login server 120'; a bidder database 130'; a auction database 140'; one or more auction servers 150'; and a plurality of client machines 160. As shown in FIG. 6, each client machine is equipped with a

global synchronization unit 175 (GSU), whereas the primary server 100' and each auction server 150' is equipped with a standard GPS receiver 170. As shown in FIG. 6, the auction-supporting system of the illustrative embodiment employs a global positioning system comprising GPS receivers 170 operating in conjunction with an array of GPS satellites 180 occupying a geodesic orbit in a manner well known in the satellite art. All of the computer and database components of the system are interconnected through some sort of communications network 190 such as the Internet, supporting a networking protocol such as TCP/IP.

Overall regulation of the auction activity enabled by the system and method of the present invention is carried out by a computer or set of computers which hereinafter shall be referred to collectively as the "primary server" denoted by reference numeral 100'. The primary server provides certain functionalities to the system including, for example: acting as a source of descriptions for products and objects to be sold by way of auctioning processes well known in the art; providing a master clock for the system; determining the overall ranking of bidders; selecting the highest bidder in the auction (i.e. contest); and informing the bidders (i.e. contestants) and possibly the general public of the identity of the wining bidder.

As shown in FIG. 6G, the primary server 100' in the auction-promoting system comprises a number of software and hardware components. As shown in FIG. 6G, the structure of the primary server 100 is described using the layered structure of a standard general purpose computer, wherein the hardware components are shown at the lowest level, with successive layers of software functionality disposed above them. Each layer of components utilizes and builds upon the services and capabilities of the lower layers, most often only directly interfacing with the layer immediately below it. In the primary server 100', the low level hardware includes a GPS receiver 170, and high precision clock and timing hardware 200 synchronized to a global time reference using the GPS receiver. In addition, the high performance network interface hardware 210 is used to connect the primary server 100' to the communications network 190. These hardware components are in addition to the standard I/O and other hardware 220 typically provided on a high-end network server, such as the SUN Enterprise™ server running the Solaris™ platform, by Sun Microsystems, Inc. of Palo Alto, California. Above the hardware level are standard and customized device drivers 230 that control and communicate directly with the hardware. The device drivers are used by the operating system 240 and higher-level applications so that direct hardware programming is not necessary. At the top level of FIG. 6G are two auction-related applications. The first application is the

primary server daemon 250'. This piece of software manages the sequence of operations for the auction (i.e. contest) as a whole, as well as managing the communication of queries, responses, and other information with the game servers. The other top level application running on the primary server 100 is the auction management interface 260'. This application provides the user interface to the human operators of the auction. This software allows the operators to enter new bids into the Auction Database 140', to set up and schedule auctions, to set bid levels (e.g. starting bids on particular items scheduled for auction), to specify qualifications (e.g. financial qualifications) for participating in particular auctions, to collect and view usage statistics, and to monitor ongoing auctions. The auction management interface application 260' communicates with the primary server daemon 250' in performing most of its tasks.

As illustrated in FIG. 6A, the single primary server 100' communicates indirectly with the client machines 160 through a number of auction servers 150'. These auction servers 150' relay current bids to the client machines, and receive responses (e.g. counter bids) from those client machines. Analysis and sorting of the response bids is performed by the auction servers 150, and these pre-processed results are then passed back to the primary server 100'.

As shown in FIG. 6E, the auction server 150' has a layered architecture similar to the primary server 100', comprising: hardware components including a GPS receiver 170; high precision timing hardware 200; a high performance network interface 210; in addition to the standard hardware components 220. These hardware components are controlled through the use of a set of standard and customized device drivers 230. Many of these device drivers are provided by the hardware manufacturers, while some are specifically written or modified to handle the precise timing operations needed by the auction-supporting system of the present invention. The major application running on the auction servers is the auction server daemon 270'. The auction server daemon 270' receives, processes and responds to data from the primary server 100, the login server 120, and from its client machines 160.

Each bidder interacts with the auctions-supporting system through a client machine 160. Each bidder uses a single client machine 160 to receive and view the starting/minimum bid, current bids, as well as to enter and transmit their counter-bids to current bids. In the illustrative embodiment, each client machine may be realized as a standard personal computer, augmented by the addition of several software and hardware components. In FIG. 6D, the basic components of each client machine 160 is shown. As shown in FIG. 6D, each client machine 160 would initially comprise the standard hardware and software

components typically associated with any personal computer. These components would include the operating system 240, standard device drivers 280, clock or timer hardware 290, input hardware, such as the keyboard, mouse, a microphone, etc. 300, output hardware, such as a video display and/or speakers 310. In addition to this hardware, each client machine would also require some sort of "web browser" 320 such as Netscape Navigator or Microsoft's Internet Explorer. This web browser is used to contact the "Auction WWW Site", to register with the auction-supporting system, and to download the other software components therefrom. These other components might include a auction plug-in 330 that would enhance the user's experience at the auction web site, in addition to the auction client 340, which is the primary interface between the bidder and the auction system. Each auction client machine receives and presents bids to the human bidder, as well as accepting the bidder's responses (i.e. counter bids) and sending them to the servers. Each auction client machine communicates through auction hooks and drivers 350' with the underlying input, output, and timing hardware, in order to handle the timing aspects of the auction (i.e. contest). The hooks and drivers 350' are responsible for clock and display synchronization, as well as for generating time-stamps associated with various events during the auction. The global synchronization unit (GSU) 175 is installed in the client machine to provide precisely timed events, traceable to internationally standardized reference clocks. The GSU 175 of each client machine performs decryption operations, time-stamping of client-machine/contestant responses, and supports timed query presentation.

When not actually participating in an auction, the bidder interacts with the auction web site through a web browser. The auction web site is "served" to that browser from one or more web servers 110. The web servers handle advertising, support, registration, downloading, and other similar tasks. As shown in FIG. 6F, the web server 110 comprises a number of major components comprising a standard I/O 220; a high performance network interface 210; standard device drivers 280; and the operating system 240. These components cooperate to support the operation of the web server software 360. The web server software 360 consists of an HTTP daemon, along with various scripts and utility programs used to handle user/bidder registration and to perform auction web site updates as new bidders or auction results information become available.

As shown in FIG. 6, the last primary computer-based component of the auction-promoting system is the login server 120. The function of the login server 120' is to accept login requests from each bidder's client machine, and assign an appropriate auction server 150' to that client machine. The login server 120' provides a single, well-known address for the client machines to

contact when initializing a new auction. The login server also serves to intelligently distribute the processing and communications load among the auction servers 150'. As shown in FIG. 6H, the login server 120' comprises a number of major components, namely: a standard I/O 220; a high performance network interface 210; standard device drivers 280; and the operating system 240. These components cooperate to support the operation of the login server daemon 370, which handles the login requests and server assignment functionality within the auction-promoting system.

As shown in FIG. 6, the auction-promoting system of the illustrative embodiment employs two database systems. The first database system is the bidder database 130'. The bidder database records information about the users, such as their identity, preferences, contact information, and auction results and standing. The second database is the auction database 140'. The auction database 140' stores the various bids made by the bidders during auctions. The starting/minimum bids for each auction are originally set and stored in the database by the auction operators (and/or the owners of the object to be auctioned). They are then accessed and distributed by the primary server 100 to the bidder's client machines 160 during the auction process.

As shown in FIG. 6, the final component of the auction-supporting system that deserves mention is the communications network 190. In general, communications over the network could be carried out using a variety of different communications methods. In general, each computer or device will establish a connection or connections to one or more of the other computers through the network 190. In practice, these connections will be "virtual" connections through a general network such as the Internet, rather than as a direct point-to-point physical connection. The topography of the primary virtual connections between the various auction system components are depicted in FIGS. 6A, 6B, and 6C, while the information flows transmitted through those connections are detailed in FIGS. 7A through 7G.

Virtual Communication Links And Hierarchies In The Action Supporting System Of The Present Invention

Typical auctions implemented using the auction-supporting system of the present invention could involve thousands or even millions of bidders distributed over and possibly above the planet Earth. Because of the huge bandwidth required to handle transmission of the queries and responses from all of the client machines employed in the auction, the system of the present invention utilizes a hierarchy of servers illustrated in FIG. 6A. As shown in FIG. 6A, the primary server 100' acts as the root node of a tree-type interconnection

of computers. The "leaves" of the tree structure are formed by the client machines 160 connected to the system. Between these devices lies a layer of auction servers 150' which act as intermediaries (or "branch structures") between the primary server 100' and the client machines 160. Each auction server communicates directly with the primary server 100' and with a set of client machines associated with that particular auction server 150'. In a large auction involving many thousands of bidders, there might be hundreds or thousands of auction servers deployed in the system, each handling hundreds or thousands of client machines. These auction servers could be distributed over the country or over the world, with each auction server handling client machines in a certain region, thereby greatly reducing the communications loading on central "trunk" network links. As shown in FIG. 6A, there are also communication links between the primary server 100' and the bidder database 130 and the auction database 140. In this illustrative embodiment of the auction-supporting system hereof, each game server 150', client machine 160, and primary server 100' is equipped with a GPS receiver that is used to synchronize the local clock and the display of each client machine participating in the auction-supporting system.

Network traffic bandwidth associated with the higher level servers in the hierarchical configuration shown in FIG. 6 is reduced by performing some data processing on the auction servers 150' themselves, rather than performing all computations on the primary server 100'. For example, if a single winning bidder, or a certain number (e.g. n) of bidders are to be chosen in each auction, then each auction server 150' can compare each bid it receives and only transmit the "n" highest bids (i.e. prices) onto the next higher level server. Also, management of time synchronized messaging with each client machine can be carried out by the auction server 150' associated with that client machine, rather than by the primary server 100'. Such techniques will serve to reduce the loading on the primary server 100'. If the performance of all bidders is to be rated and sorted, then each auction server 150' can sort the bidders playing on the client machines connected to that auction server 150' . Thereafter, these sorted lists of client machines can be easily and efficiently sorted by the primary server 100 using an insertion sort or method that takes advantage of the pre-sorted groups of contestants.

It is recognized that real world auctions involve much more than the actual bidding process that makes up the core elements of the auction. Many other steps and processes are necessary or desirable both from the point of view of the bidder, as well as from the point of view of the person or company running the auction. While the purpose of the auction from the point of view of

the bidder is to purchase a valuable object, the purpose of the auction from the point of view of the auction operator may include other goals. For example, such goals may include: selling other products or services; advertising; collecting marketing information or other statistical information; promoting their company or institution; educating a group of people; and so on. The basic bidding activities constitute the auction itself, while the other activities referred to above will be referred to as the non-auction activities. These non-auction activities can be divided into two major categories; those activities that directly support the operation of the auction; and those activities that are ancillary to the auction.

Non-auction activities that directly support the operation of the auction include one-time or rarely performed activities, as well as activities that must be performed immediately before or after each auction. One-time activities include bidding registration, system testing and qualification, and downloading plugins or other client-machine based components. Those periodic activities that must be performed before or after each auction include login, server assignment, and viewing auction results.

Registration is used to collect and record information about each contestant desiring to participate in a scheduled contest (e.g. listed on the Contest WWW Site). This information can include the name, address, telephone number(s), E-mail address, and any other information required or desired of each contestant by the contest organizer and/or sponsor(s). The contestant chooses or is assigned an identification number (or "handle") and a password, in order to protect their access to the contest process. At registration time, a number of tests may be performed on the bidder's system. These tests could be used to qualify the client machine to be used by the bidder, by determining whether it meets certain requirements necessary to successfully participate in the auction. In addition, data produced as a result of these tests may be recorded, either on the client machine or on one of the servers. This data could be used, in conjunction with other information collected during and/or after the auction, to help determine whether the auction participated fairly in the competition. Another activity which is also performed before the contest is downloading any programs, installable components, and plugins, as well as any data required by them. These programs, components, and plugins, along with a browser or other programs already present on the bidder's system will be used to present advertising and other information and content to the auction, as well as to perform all operations of the auction on the client machine.

As shown in FIG. 6B, a number of system components are used to distribute and present HTML (or XML) encoded documents (with or without Java or Active-X applets) and associated web content to the bidder. As shown, such

system components include a plurality of mirrored web servers 110, wherein each web server 110 is connected to auction database 130' and each serves a set of Web-enabled client machines 160 equipped with web browsers 320. A master web server 110 stores and provides the web site content to a set of client machines, utilizing HTTP, FTP, and other standard Internet protocols. In order to avoid overloading a single web server with many thousands or millions of connections, a number of mirror web servers 110 are used. The master web server transmits copies of the entire auction web site to the mirror web servers, which then are each able to serve a large number of client machines 160. As shown, each of the web servers 110 shares a common networked auction database 130' which contains registration and other information. In addition to providing the auction "web site", the web servers also distribute the auction client software (340) using the HTTP or FTP protocols. Before downloading auction client software, each bidder /user is required to register on the web server 110. Registration involves filling out a web-based (e.g. HTML-encoded or XML-encoded) form containing the necessary personal and client machine information and submitting that form to the web server. Client machine qualification may be tested using either browser plug-ins or stand alone test programs downloaded from the web server.

In an extremely large multi-bidder auction, it is clear that multiple auction servers will be necessary to handle communication with all the client machines involved during the auction. When a client machine initially connects to the auction-supporting system of the present invention, it will be done through a login server 120' located at some well-known Internet address. The login server will choose which game server should be utilized by this bidder's client machine. This choice will be based on a variety of information, including the location of the client machine, the characteristics of the connection to the client machine, and the number and characteristics of the connections already assigned, or anticipated to be assigned, to the auction servers in the system. Load balancing algorithms will be used to distribute the connections to the auction servers, thereby minimizing the possibility of overwhelming any one server, and ensuring consistent connections for all the auction client machines.

FIG. 6C depicts the connections between the client machines 160, login server 120', and the bidder database 130'. Except in extremely large configurations, it is probable that only a single login server would be needed, and all client machines would receive their auction server assignments from that server. If a single login server is insufficient, then a hierarchical configuration similar to the one shown for the auction servers in FIG. 6B could be used. As shown in FIG. 6C, each client machine is running the auction client 340', and it

is this software that the bidder interfaces with when logging in to through the login server. In order to check passwords and the status of the bidder, the login server accesses the bidder database 130'.

Processes Involved During The Operation Of The Auction-Supporting System Of The Present Invention

In FIG. 7, the high level operations performed by the auction-supporting system of FIG. 6 are described. Collectively, these operations enable a bidder to compete with many other bidders, in a secure and fundamentally fair time-constrained auction, wherein each bidder is provided with a common "start-time" regardless of the location of his or her client machine on the infrastructure of the Internet, for the type of interconnection provided thereto (e.g. POTS line, ISDN, frame-relay or T1 line). The flowchart of FIG. 9 sets forth the eight basic steps or operations carried out by the auction-supporting system of FIG. 6. These operations are indicated at Blocks A through H in FIG. 9. As a overview of the method hereof, these operations will be first briefly described below, and thereafter, each operation will be described in greater detail with reference to FIGS. 4A through 3G, respectively.

As indicated at Block A in FIG. 9, the first major operation carried out by the auction-supporting system hereof involves registration of each user as a bidder, and downloading of auction software to enable the creation of a globally-synchronized and secure networked client machine through which the bidder may participate in a time-constrained auction, while competing against large numbers of other bidders.

As indicated at Block B in FIG. 9, the second major operation carried out by the auction-supporting system hereof involves the bidder using the auction client software on the client machine to log on to the auction server 150', and the establish a communication channel therewith.

As indicated at Block C in FIG. 9, the third major operation carried out by the auction-supporting system hereof involves transmitting encrypted auction information and start-time from the primary server to the client machine.

As indicated at Block D in FIG. 9, the fourth major operation carried out by the auction-supporting system hereof involves characterization of the client machine's local clock with the master clock on the primary server, and the synchronization of the client machine display update cycle with the desired start-time for the auction.

As indicated at Block E in FIG. 9, the fifth major operation carried out by the auction-supporting system hereof involves presenting the starting bid (and other bidding information) to the bidder precisely at the start-time, as

determined by a local clock that is characterized with respect to a global master clock located on the primary server.

As indicated at Block F in FIG. 9, the sixth major operation carried out by the auction-supporting system hereof involves accepting the bidder's response (i.e. counter-bid), attaching a time-stamp to that response, and transmitting the response and time-stamp to the servers.

As indicated at Block G in FIG. 9, the seventh major operation carried out by the auction-supporting system hereof involves judging the bids from all the bidders and determining the bidder placing the highest bid on the auctioned item. In addition, each bidder's standing or rank is determined for the auction.

Details Relating The Operation Specified In Block A In Fig. 9

In FIG. 9A, the suboperations are shown for carrying out the method of registering and downloading of auction software indicated at Block A in FIG. 9.

As indicated at Block A in FIG. 9A, a potential bidder browses the contest WWW site ("the auction web site"). In general, the auction web site will include information about the auction, including descriptions of the auction client software, auction qualifications, auction regulations, instructions on how to play, information about different varieties of the auction, lists of prizes and awards offered, advertising, lists of auction sponsors, lists of previous winners, and the standings or ranks of other bidders. FIG. 7A indicates the flow of information between the user's client machine 160 and the web server 110 containing HTML (and/or XML) encoded documents comprising the auction web site. In this figure, as well as in FIGS. 7B through 7G, the large arrows extending from one computer to another represent a message or group of messages containing related information. Messages indicated by 400 in FIG. 7A contain the web auction being delivered to the client machine 160 from the web server 110.

In addition to the informational content of the auction web site, provision will also be made to allow the user to register to become a bidder. As indicated at Block B in Fig. 9A, upon deciding to enter the auction, the user fills out an on-line registration form, using either standard HTML (or XML) forms, or forms generated by Java or Active-X applets, or by a CGI script in a manner well known in the art. During the registration process indicated at Block B in Fig. 9A, there may also be a qualification procedure, wherein the user performs some test either of their own abilities and/or of the capabilities of their computing system. These tests could be administered through forms along with the registration process, or could involve the user downloading and running customized plug-in modules or stand-alone applications on his or computing system. Message 405 in FIG. 7A contains registration information being transmitted from the client

machine 160 to the web server 110. This information is encrypted using standard secure HTTP methods known in the art.

As indicated at Block C of FIG. 9A, the web server 110 creates a record in the auction database 130' for this user upon completing receipt of the registration information therefrom. The registration information is stored in this record, establishing the user as a bidder permitted to participate in one or more on-line multi-bidder auctions to be promoted (i.e. enabled) the system of the present invention.

As indicated at Block D of FIG. 9A, a bidder identification (i.e. ID) is then assigned to the new auction. This ID code uniquely identifies the bidder for all time, unlike a username, password, e-mail address or other information that may be changed in the future by this bidder. The bidder ID is recorded in the bidder database 130', and is used internally by the auction software of the system.

As indicated at Block E in FIG. 9A, the bidder is assigned a username and a temporary password for use when participating in the auction. The username may be assigned by the system, or it may be chosen by the user as a part of the registration procedure. The password is generated randomly, and will most likely be changed by the auction after logging into the system the first time. The username and password are stored in the auction database 130'.

As indicated at Block F in FIG. 9A, an e-mail message containing the username and temporary password are sent to the bidder. This e-mail message from the web-server 110 to the client machine 160 is depicted as Message 410 in the data flow process shown in FIG. 7A.

As indicated at Block G in FIG. 9A, the bidder logs onto a secure, members-only area of the auction web-site using his or her username and temporary password. This area allows the bidder to view and update his or her personal information (e.g. username, password, e-mail address, residence address and telephone numbers, and so on).

As indicated at Block H in FIG. 9A, the bidder downloads the auction software from the web server 110 to his or her client machine 160, i.e. from the members-only area of the auction web site. This auction software download is accomplished using HTTP, FTP, or other file transfer protocol, as represented by Message 415 shown in the information flow proceeds of FIG. 7A.

As indicated at Block I of FIG. 9A, the bidder installs the client software on his or her machine. This procedure will involve either executing the downloaded installation file, or initially decompressing the downloaded file and then executing a setup application contained within the compressed archive. The installation procedure will install the auction client 340' application, as well as one or more customized device drivers 350 required by the bidder's client

machine. The device drivers will be used to communicate directly with the local clock and any timing hardware (GPS, etc) used in the client machine. Upon successful installation of the client software, the bidder's computing system will become a fully enabled "client machine", and thus ready to participate in a contained competition in accordance with the principles of the present invention.

Details Relating The Operation Specified In Block B In Fig. 9

In FIG. 7B, the suboperations are shown for carrying out the method of logging a bidder onto the auction server 150' indicated at Block B in FIG. 9. In general, this procedure involves a number of "behind-the-scenes" activities by the various server systems, in addition to the actual log on process. Initially, all servers and clients in the system are provided with the address of the login server 120 as well as with the login server's encryption "public key", which is used to send secure message to the login server.

As indicated at Block A in FIG. 9B1, the primary server 100 transmits a list of all the participating auction servers to the login server 120. This message, shown as 420 in FIG. 7B, is encrypted using the login server's public key. The login server 120 decrypts and stores this message using its private key.

As indicated at Block B in FIG. 9B1, the login server sends a status request message to each of the auction servers. In FIG. 7C, this status request message is indicated by Message 425.

As indicated at Block C in FIG. 9B1, each auction server 150' sends a reply in response to the status request message (i.e. Message 425), containing information about the status of the auction server, including current loading, indications of maximum server capacity, geographical area of coverage, and other information. In addition, this reply contains the auction server's public encryption key. The entire reply, indicated by Message 430 in FIG. 7C, is encrypted using the login server's public key. Status request message 425 and response message 430 occur during the initialization of the auction system, as well as periodically throughout the operation of each auction enabled by the system hereof.

As indicated at Block D in FIG. 9B1, the bidder must log on to the system using the auction client application when the bidder decides to participate in a particular auction. During this stage of the process, the auction client machine 160 requests a username and password from the bidder for the convenience thereof. This username and password may be stored locally on the client

machine to avoid the bidder having to re-enter the username and/or password every time he or she participates in an auction.

As indicated at Block E in FIG. 9B1, the auction client software 340' transmits the username and password to the login server 120'. The username, password, and the client machine's public key are first encrypted using the login server's public key, and the resulting login request, indicated as Message 435 in FIG. 7D, is sent from the client machine 160 to the login server 120'.

As indicated at Block F in FIG. 9B1, the login server 120' decrypts the login request, obtaining the username and password. The username and password are obtained by performing a lookup operation in the bidder database 130', thereby obtaining a bidder ID.

As indicated at Block G in FIG. 9B1, the bidder ID is transmitted to the client machine 160, as Message 440 shown in FIG. 7D. The client machine 160 stores this ID for later use.

As indicated at Block H in FIG. 9B1, the login server 120 selects an appropriate game server 150 for this contestant, based on loading, geographical location, and other factors.

As indicated at Block I of FIG. 9B2, upon selecting an auction server, the login server 120' sends a login request, indicated as Message 445 in FIG. 3C, containing the bidder ID and the client machine address to the selected auction server. This message 445 is encrypted using the auction server's public key. If the login request is granted, then the auction server 150' creates a message containing an auction server access code, indicated as Message 450 in FIG 7C, encrypted using the login server's public key.

As indicated at Block J in FIG. 9B2, this message (containing the auction server access code) is sent from the auction server 150' to the login server 120'. Notably, the auction server access code is a key created using the bidder ID and the client machine address. This code will only allow the specified bidder to log in using that code.

The login server decrypts Message 450, and then creates a new message, indicated as Message 455 in FIG. 7D, containing the game server's address and the auction server access code.

As indicated at Block K in FIG. 9B2, Message 455 is encrypted using the client machine's public key, and sent from the login server 120 to the client machine 160.

The client machine decrypts Message 455 containing the game server address and the auction server access code using its private decryption key. The client machine then creates a message, indicated as Message 460 in FIG. 7D, containing the bidder ID, the auction server access code, and a client machine

public encryption key. As indicated at Block L in FIG. 9B2, Message 460 is sent from the client machine 160 to the auction server 150' specified by the auction server address received from the login server 120'. The auction server 150' responds with Message 463 containing the auction server public key. At this point, the client machine 160 has successfully logged on to the auction server 150' chosen for the client machine by the login server 120.

Details Relating The Operation Specified In Block C In Fig. 9

In FIGS. 9C1 and 9C2, the suboperations are shown for carrying out the method of downloading an encrypted auction information and start-time to the client machine indicated at Block C in FIG. 9.

As indicated at Block A in FIG. 9C1, sellers of items to be auctioned enter auction information (e.g. description of the auction item, minimum start bid, etc.) into the auction database 140.

As indicated at Block B in FIG. 9C1, at some point before the auction begins, the auction server 150' sends to the primary server 100, a message, indicated as Message 465 in FIG. 7F, containing the auction server public encryption key.

Similarly, as indicated at Block C in FIG. 9C1, the primary server sends to the auction server 150', a message indicated as Message 470 in FIG. 7F, containing primary server public encryption key.

As indicated at Block D in FIG. 9C1, when a particular auction is created, the auction operator or primary server software, accessing the system through the auction management interface 260', select the action start-time from the auction database to be used in the auction. Selecting auction start-times could also be done automatically by the auction management interface software.

As indicated at Block E in FIG. 9C1, for each auction, the primary server generates a unique set of encryption and decryption keys.

As indicated at Block F in FIG. 9C1, using the auction encryption key, the primary server 100' encrypts the auction information.

As indicated at Block G in FIG. 9C1, the primary server 100' creates a message M1, indicated as Message 475 in FIG. 7F, containing the encrypted auction information, the auction decryption key, and the auction start-time.

As indicated at Block H in FIG. 9C1, the entire Message (M1) 475 is encrypted using the auction server's public encryption key.

As indicated at Block I in FIG. 9C2, the entire Message (M1) 475 is sent from the primary server 100' to the auction server 150'.

As indicated at Block J in FIG. 9C2, upon receiving the Message (M1) 475 from the primary server 100', the auction server 150' decrypts the Message (M1) 475 and creates a new message (M2), indicated as Message 480 in FIG. 7F, containing encrypted auction information (e.g. bid) and its start-time.

As indicated at Block K in FIG. 9C2, this new Message (M2) 480 is encrypted by the auction server using the auction client machine's public key.

As indicated at Block L in FIG. 9C2, the resulting encrypted Message (M2) 480 is sent to the client machine.

As indicated at Block M in FIG. 9C2, the client machine decrypts the Message (M2) 480, and stores the encrypted auction information (e.g. bid) and the start-time contained therewithin, the client machine 160.

At this point, the client machine 160 creates and begins appending data to a security verification log file. This encrypted file will contain a variety of information about the timing of the bid/response process. Among other data, the security verification log will record the arrival-time (in local time) of the encrypted query from the auction server 150'.

Details Relating The Operations Specified In Block D In FIG. 9 Without Using The GSU Of The Present Invention

It is understood that any of the embodiments of the GSU described above can be used in connection with the auction-supporting system of the present invention. However, in FIG. 9D, a method is shown for characterizing the client machine local clock and synchronizing the client machine display update cycle indicated at Block D in FIG. 9, without utilizing a global synchronization unit (GSU) as described hereinabove.

As indicated at Block A in FIG. 9D, the local clock is "characterized" by each client machine using statistical sampling and curve-fitting techniques, to determine the functional relationship between the local clock t_l and a global clock t_g. This process of characterization can be understood as follows. Given an abstract idealized "universal clock time", t , a local clock $t_l = f(t)$ (e.g. the system timer, real time clock, or for greater precision, the CPU clock cycle counter), and a global clock $t_g = g(t)$ maintained on the primary server, the local clock is said to be "characterized" when it is expressed as a function of the global clock value, $t_l = f(g^{-1}(t_g))$. Characterization of the local clock with respect to the global clock will be defined as determining some function $h(x) = f(g^{-1}(x))$. Over reasonable time periods, and assuming fairly high quality timing hardware, h(x) will be well approximated by a linear function. The simplest method of determining this function is to use standard curve-fitting techniques. If the global clock on the primary server 100' is a GPS-based time reference, the local clock may be

characterized very precisely by also using a GPS reference in the client machine. The GPS hardware can easily produce an extremely accurate and stable 1 Hz signal. This signal is connected to one of the CPU IRQ lines. This causes the CPU to enter an interrupt service routine every second. At the instant the interrupt is triggered, the CPU can record the reading of the local clock (CPU cycle counter register). After collecting a number of such samples, the function h(x) may be approximated to a high degree of accuracy.

The statistical information collected in order to determine the clock characterization function is appended to the security verification log.

As indicated at Block B in FIG. 9D, after determining h(x), the client machine then uses this function to calculate the local clock start time (t_{sl}) corresponding to the desired global clock start-time (t_{sg}) for the auction.

Next the video display update cycle is measured using the local clock. Almost every video display adapter used in personal computers has a set of registers used to control and monitor the scanning and refresh periods and rates. One standard function is the ability to query the adapter to determine whether it is currently in a vertical retrace period or not. By using this function over a period of time, and recording the local clock time each time the display enters vertical retrace, the period and phase of the display update cycle is determined with respect to local clock time. By reading the display adapter registers, it is simple to determine the difference between the time the last line of the displayed image is drawn and the beginning of the next vertical retrace. The instant that the last line of the display is drawn in any display update period will be referred to as the display time (t_d). Using this calculated period and phase the display times are extrapolated forward in time to find the display time closest to the desired start-time.

As indicated at Block C in FIG. 9D, the client machine calculates the error (E_d) between the desired local clock start-time (t_{sl}) and the closest display update cycle (i.e. display time (t_d)). Throughout this process, the times associated with each vertical retrace are appended to the security verification log.

Since it is desired to have the client machine display bid information simultaneously on all client machines, the error term E_d is minimized by shifting the phase of the display update cycle. A value of 0 for E_d indicates that the display will complete drawing the given image at the precise moment of the start-time. The phase of the display update cycle is adjusted by increasing or decreasing the display update period over a number of update cycles. This period is typically determined by several registers on the display adapter, controlling the so-called "vertical total", "horizontal total", and the "dot clock". The vertical total is the total count of lines, both displayed and non-displayed

(within the vertical blanking and retrace period), that make up one display update cycle. Similarly, the horizontal total measures the number of pixels, both displayed and within the horizontal blanking and retrace period. The dot clock frequency determines the number of pixels per second rendered to the display. By adjusting any one of these three values temporarily, the period of the display update cycle may be changed, again temporarily. Although it might be possible to align t_d with t_{sl} within a single update cycle, it is probably not desirable to make such a large modification to the display update period, since this can cause monitor clicking and may temporarily disrupt the displayed image. Instead, the display update period is modified only slightly (perhaps adjusting the vertical total by one or two lines), and the period is left adjusted until enough phase shift accumulates to reduce E_d to near zero, at which time the display update period is restored to its original value. This alignment of the display update cycle with the desired start-time satisfies the criteria set forth at Block D in FIG. 9D.

Note that depending on the accuracy of the clocks, the frequency drift of the clocks and the refresh update cycle, and the distance into the future that the display time is extrapolated, it may be necessary to repeat the alignment procedure to reduce these errors. The display time alignment procedure should be considered an ongoing process, perhaps being performed concurrently with other steps in the contest process. As always, information about this process is recorded in the security verification log, providing a continuous trace of the operations taking place and the timing of those operations.

Details Relating The Operation Specified In Block E In FIG. 9 When Not Using The GSU Of The Present Invention

FIGS. 9E1 and 9E2 show the suboperations for carrying out the method of presenting the auction information to the bidder at the auction start-time indicated at Block E in FIG. 9, for a system that does not utilize a global synchronization unit, as shown in FIG. 2D, for example. At this point, the encrypted bid information has been stored on the client machine, the start-time is known in terms of the local clock, and the display time has been aligned with the desired start-time.

As indicated at Block A in FIG. 9E1, the auction server opens bidding for item A (e.g. an article to be auctioned) at time t_1.

As indicated at Block B in FIG. 9E1, the auction server is able to accept bids for item A that are time-stamped after t_1.

As indicated at Block C in FIG. 9E1, the client machine sends a bid for item A to the auction server at time t_2 and time-stamps its time of transmission using the local clock which has been characterized using the GPS, as described above.

As indicated at Block D in FIG. 9E1, the auction server receives the bid from the client machine at time t_3 and time-stamps its time of receipt using the local clock which has been characterized using the GPS, as described above.

As indicated at Block E in FIG. 9E1, the auction server sends to the client machine a confirmation of the bid receipt containing the time-stamps.

As indicated at Block F in FIG. 9E1, the auction server updates all competing client machines (i.e. bidders) with the highest bid information for item A.

As indicated at Block G in FIG. 9E1, the system continues the operations set forth at Blocks C and D until the auction server no longer receives any bids for a predetermined amount of time (e.g. x seconds).

As indicated at Block H in FIG. 9E1, the auction server sends all participating client machines a notice of final bids at time t_4.

As indicated at Block I in FIG. 9E2, the auction server waits a second predetermined time period (i.e. y seconds) for a new bid from any client machine participating in the auction.

As indicated at Block J in FIG. 9E2, at t_4 + y seconds, the auction server closes the bidding process.

As indicated at Block K in FIG. 9E2, the auction server waits z seconds for any bids time stamped prior to t_4 = y seconds.

As indicated at Block L in FIG. 9E2, the auction server determines whether a new higher bid has been received, and if so, then returns to Block F in the process loop.

As indicated at Block M in FIG. 9E2, if the auction server determines that at Block L that no higher bids have been received, then the auction server determines that item A is sold to the highest bidder, and then the auction server updates all client machines with the final sales price at which the item has been sold.

By carrying out accurate time-stamping at both the client and server ends of the auction process, each bid message carries two time-stamps (i.e. one produced at the client machine and one at the auction server) and therefore can be reliably accepted based upon the submission-time of the bid at the client machine and not upon the receipt-time thereof at the auction server. Consequently, this enables auction server to accept the highest bid provided that its time of bid placement at the client machine falls within the predetermined bid window, and not when they are received at the server. In a fast paced, real-

time auction, this feature of the present invention might be a significant factor in achieving a fundamentally fair auction process.

The high-level bidding process described above has been described in connection with an auction-supporting system having GSP-enabled client machines as shown in FIG. 2D. It is understood, however, other types of client machines, such as those disclosed in Figs. 2D1 through 2D5, can be used to practice the auction-supporting system and method of the present invention. Such modifications are described hereinabove in connection with the generic contest-promoting system of the present invention.

In general, the auction-supporting system of the present invention can be used to auction off virtually any item of value such as, for example: antiques; commodities; consumer goods; personal articles and effects; real estate including tracts of land as well as condominiums; licenses to use intangible properties (e.g. bands of the electromagnetic spectrum, patents, etc.); transferable club memberships and subscriptions; and the like.

While the auction-supporting system of the present invention has been described above in connection with an Internet-based process involving many bidders simultaneously bidding on a single auction item, it is understood that such bidders could be bidding on multiple items in a multi-item combinatorial auctions, as well as any variations thereof.

In many applications, the bidders will be human beings using GSU-enabled client machines. However, it is understood that there will be many present and future applications in which the bidders will be intelligent software-based robots (commonly referred to as "BOTS") programmably engaged in real-time, time-constrained competition for valuable resources over the Internet. In such embodiments of the present invention, the client machines can provide a host environment for these bots to participate in time-constrained contests and other forms of competitive behavior for recognition and/or rewards in accordance with the principles of the present invention.

It is also understood that the auction-supporting system of the present invention can be used to support many different types of auction-based processes including, for example, the sale of financial securities (e.g. stocks and bonds), options, futures, commodities, foreign currency, and the like, wherein a group of competitors or contestants (e.g. bidders) are required to compete for the acquisition (e.g. purchase or lease) of an item of value in a time-constrained manner over the Internet or other information network.

Modifications of and Extensions to The System of the Illustrative Embodiments

Although the illustrative embodiments of the global synchronization unit (GSU) utilize a global positioning system (GPS) receiver as a source of time and space data, the present invention contemplates the existence and possible value of current and future alternative means of obtaining time and space information.

For example, Loran-C systems are widely used for determining maritime location and time information, and is also available for land-based systems in many parts of the world. This type of system could be used in a similar manner to the GSP receiver, although with a somewhat lower precision and accuracy.

Time signals can be produced from a periodically-synchronized free-running clock (ranging from a standard quartz-crystal based clock to an atomic clock). The accuracy of these signals of course depend on the stability of the clock and the frequency at which the clock is synchronized with some global clock.

Time signals are also available using a standard radio receiver from the NIST WWV and WWVH time and frequency service broadcast stations. Because the time signals are sent by radio waves from one or more fixed transmitting towers, there is a time latency due to the speed of propagation of the radio waves. This latency is affected not only by the straight line distance to the transmitter, but also by the actual path taken by the radio waves to reach the transmitter, which may involve reflections from natural or man-made objects. This latency may be compensated to some extent using the physical location of the receiver unit. After determining the unit's location, using cellular telephone data, user-entered location information, or other means, the estimated latency for that location can be determined, using a lookup table or other means. The expected latency can then be compensated for to arrive at a more accurate time value.

Because of the phenomenal popularity of the GPS system, it is certain that more advanced time and space determining systems will be developed in the future. The basic GSU concepts will surely benefit from the improvements in performance and convenience provided by such anticipated developments in these systems.

Any attempt to synchronize the processing of data at distributed locations, where the data originates at a single central location, is fundamentally constrained by the latency and bandwidth of the connections between the distributed locations and the central location. The latency of the communications channel is a measure of the time delay between the instant a piece of information is sent from the originator and the instant that information is received by the receiver. Latency is expressed in units of time, for example a

"1 second latency". The bandwidth is a measure of the rate of information flow from sender to receiver in terms of information units per unit of time, for example bits per second. Assuming a one way flow of information from the sender to a set of receivers, where the information is broken down into discrete units (packets, messages, files, etc), as might be the case with stock "ticker" information, it may be desirable to synchronize the times that these units are made available to the receivers. In other words, for a given unit sent from the sender to all the receivers, it is desirable that the unit to becomes available for use on all the receivers simultaneously, despite the differing latencies of the various connections. This goal is accomplished by considering the expected value of the longest latency among all the connections. In order for the unit to be received by each receiver before the desired synchronization time (or start-time), the units must be sent out to each receiver at a time early enough to at least compensate for the latency to that receiver. In fact, the data unit must be sent earlier still to allow for the stochastic nature of communications delays as well as to allow for the time for the receiving GSU to process and decrypt the information.

Thus, in a stock market "ticker-tape" application, stock prices are determined at a central location as a function of the various offers to buy and sell (and other factors) in effect at that time. When a stock price becomes available at this central location, it is then sent to all of the remote GSU-equipped terminals, along with an indication of the desired time to display the stock price (the "start-time"). This desired display time must be sufficiently delayed from the time it is sent from the central location to allow for network latency and for the GSU processing time. If the worst case latency was 500ms, and the processing time was 100ms, then the display time must be at least 600ms after it is sent out. However, this stock price is just one of a stream of stock prices being produced at the central location and distributed to the remote GSU-equipped terminals. The maximum rate (stock-prices per second) of display is constrained by several factors. First, we are limited by the GSU processing time. In this hypothetical case the GSU processing time is 100ms, so the maximum display rate is 10 prices per second.

The bandwidth of the communication channel also is a factor when looking at a long term, continuous display rate. The bandwidth, as well as the size of the stock-price-containing messages limits the rate (stock-prices per second) of message sent over that link. Notably, the GSU processing time depends on whether the information is actually being displayed on a monitor, or simply being decrypted and given to a CPU. If the information is to be displayed at a time-precision moment on the order of a few milliseconds or less, then the

display must be synchronized, which can be a relatively time consuming process (on the order of many milliseconds to several seconds). This requirement can be avoided if the start-times are chosen to be in synchronization with the display update rate, however. For example, if all the displays were synchronized at a common frequency of 100Hz, and the start-times were chosen as integer-multiples of 10ms, then it would only be necessary to perform the full monitor synchronization procedure once, after which the stock prices could be updated at a much faster rate (approaching the bandwidth of the communications channel). In actual practice, multiple-stock prices can be sent as a single unit, to reduce some of the GSU processing overhead.

In each of the client machines of the present invention, there is provided a GSU, which combines a GPS clock with an encryption mechanism for digitally signing data in order to provide a secure and verifiable time-stamp on each response from each competitor. This security measure may be compromised in only two ways: (1) by physically dissecting the GSU and extracting the secret key; or (2) by a computational-based attack to determine the secret key (a very time consuming process dependent on the number of bits used in the algorithms).

In order to prevent physically dissecting the GSU associated with each client machine, the present invention contemplates the use of tamper evident seals on the GSU (which would be submitted to receive the contest award), as well as techniques which result in the automatic destruction or disabling of the GSU upon tampering.

In order to render computational-based attacks on the GSU very difficult using ordinary computation means, the present invention contemplates using sufficiently long keys in the GSU so that the time involved to decipher the key would be very long, in accordance with standard security practices.

The GSU may also be used to test motor skills of human subject to detect their ability to perform a particular job--that is, determine if their motor skills are impaired by lack of sleep, alcohol, or drugs. For example, remote timed testing of truck drivers. Coupling tests with a secure camera would insure accuracy.

Alternative Applications For The Competition/Contest Promoting Systems And Methods Of The Present Invention

As explained hereinabove, the Internet-based competition and contest promoting systems and methods of the present invention can be used in the securities trading industry so that truly real-time price quotes and order execution is achieved, thereby creating a level playing field for everyone with a

financial position in the market. Also, application of the present invention to real-time auction processes will also create a level playing field for all bidders participating in on-line auctions.

The system and methods of the present invention can also be applied to the filing of patent and trademark applications in patent offices world-wide, as well as in connection with any legal document filing process where the time of filing can be of importance with respect to the rights of the parties involved. By providing truly accurate time-space stamps on legal documents, the rights of members of our society can be more fairly championed, regardless of where such parties may be physically or electronically situated.

In addition to the Internet-based game, securities trading, and auction processes described in detail above, the Internet-based competition and contest promoting systems and methods of the present invention can be used in connection with various other types of business application models including, for example: marketing driven models where contestants compete for prizes by answering questions about products and/or services; game/puzzle driven models where contestants compete for prizes by participating in games (e.g. query-based games) or solving puzzles (e.g. cross-word puzzle); education models where contestants compete for prizes by answering questions about educational topics; where contestants, as members of competing teams in a recreational league, compete for prizes by answering questions on particular topics (e.g. sports, business, recreational activities, etc.) or by responding to Invitations To Respond (ITRs) simultaneously served and displayed to a large number of competing teams, each having one or more designated representatives participating in the competition; where contestants, as members of competing corporations in a particular market, compete for prizes by answering questions on particular topics relating to their business, or by responding to Invitations To Respond (ITRs) simultaneously served and displayed to a large number of competing corporations, each having one or more designated representatives participating in the competition; where contestants, as members of competing teams in a sports league, compete for prizes by answering questions on particular topics (e.g. sports, business, recreational activities, etc.) or by responding to Invitations To Respond (ITRs) simultaneously served and displayed to a large number of competing teams, each having one or more designated representatives participating in the competition.

Time-Space Stamping Based Object Tracking System and Method Of The Present Invention

In general, the GSU technology of the present invention can be used in numerous applications involving the collection of time and/or space coordinate information in relation to objects and prespecified frames of reference. With reference to FIGS. 16 through 22, several applications will be described with time-space coordinates of objects (e.g. animate and inanimate objects alike) are collected, recorded and analyzed in order to track the position of such objects and/or determine the motion thereof within the space-time continuum. As will be described hereinafter, such basic functionalities enabled by the GSU of the present invention can enabled a wide array of novel service applications deliverable over the Internet and other globally-extensive networks.

In FIG. 16, there is shown a time-space (TS) based stamping based system for tracking mobile animate as well as inanimate objects including, for example, human beings, animals (e.g. pets, cattle, etc.) and articles of property, mobile/moveable relative to a globally-defined coordinate reference system, by internal or external forces. As shown in the illustrative embodiment, each object being tracked carries an ultra-compact or miniature client-type computing/network device embodying the global synchronization unit (GSU) or extended GSU of the present invention, as possibly other data collecting/sensing devices, as will be described in connection with the alternative embodiment shown in FIGS. 19 through 22.

As shown in FIG. 16, the TS-stamping based object tracking system of the present invention comprises: a plurality of wireless client-computing devices (i.e. machines) of ultra-compact or miniature construction embodying the GSU 175 shown in FIG. 2D2 or the extended GSU 175 shown in FIG. 2D5, each of which is operably connected to the infrastructure of the Internet (or other globally-extensive packet switching digital communications network), and is adapted for embodiment within or otherwise supported upon an object to be tracked, using suitable device mounting mechanisms and devices known in the arts; a Web-based Owner/Object Registration Information Server 1003, operably connected to the infrastructure of the Internet, for access by any Web-enabled client machine 1010 to create an Object Record and Owner Record in a Web-enabled RDBMS Owner/Object 1001 (during the Object/Owner Registration Process), for each object to be tracked by the object tracking system; TS-stamping Based Tracking Server 1000, operably connected to the infrastructure of the Internet, and in wireless communication with each GSU-enabled client-computing device 160' registered with the system, for (i) collecting time-space (TS) coordinate data therefrom as the underlying object being tracked is moved about the planet as shown in FIG. 17A (during mobile tracking applications) or in FIG. 17B (during stationary object movement detection operations); (ii) storing such collected TS

coordinate data in a Owner/Object RDBMS 1001, wherein each object, its owner, and other information are preregistered during the Object/Owner Registration Process carried out over the Internet using a simple Web-enabled client machine 1010; and (iii) analyzing collected TS coordinate data on a real-time basis to (1) determine the precise location of the object at any instant in time, relative to the global coordinate reference system, or a local coordinate reference system derived from the global coordinate reference system using homogeneous transformations, or (2) whether the object has been moved from a particular location without authorization over a given time frame; a Web-based Object/Owner Registration Server 1003, operably connected to the infrastructure of the Internet, and the Web-enabled Object/Owner RDBMS 1001, for enabling owners of objects to be tracked, and/or the agents thereof, to use any Web-enabled client machine 1010 to register themselves and their property with the system by creating, editing and deleting Owner Records and Object Records linked thereto maintained in the Owner/Object RDBMS 1001; and a Web-based Object Trajectory Monitoring Server 1002, operably connected to the infrastructure of the Internet, for enabling registered owners to monitor in real-time the position (and possibly other vital characteristics) of his or her object being tracked by the system, by reviewing TS data tables, maps, graphs, images and/or speech-synthesized reports displayed on the GUI Web-browser of a Web-enabled client machine, for analysis and subsequent action.

The GSU-Enabled Wireless Client Computing Device of Present Invention

As shown FIG. 16A, each wireless client-computing device employed in the mobile object tracking system of FIG. 16 comprises: a micro-computing platform with hardware and software components; a global synchronization unit 175 and a client computing platform supporting various hardware and software layers including client software such as a tracking client application 340', tracking hooks and drivers 350', and a wireless communications network interface 215' and the like. In the illustrative embodiment, each client computing platform may be realized as a standard palm-computer, augmented by the addition of several software and hardware components, or by Java virtual machine (JVM) chip augmented by a GSU of the present invention. In general, each client computing platform will include the operating system 240, standard device drivers 280, clock or timer hardware 290. Each client computing device communicates with the wireless communications network through hooks and drivers 350' with the underlying output and timing hardware. In order that each GSU-enabled client network device can be uniquely identified among

potentially millions of such devices, each GSU-enabled client network devices is programmed with a unique identification code (UIC) at the time of manufacture, or thereafter. Preferably, this UIC is written into a ROM chip aboard the GSU chip at the time of manufacture. As will be described hereinafter, this UIC will be used in connection with the process of generating digitally-signed time-space (TS) stamps from the GSU-enabled client network device during its trajectory through the time-space continuum.

As shown in FIG. 2D2, a basic global synchronization unit (GSU) 175 for use within a GSU-enabled client network device of the present invention would be realized in the form of an integrated circuit (IC) chip comprising: a GPS receiver 700 connected to an antenna 730; and a central processor 750 connected to the GPS receiver, for (i) storing the GSU's UIC and desired trigger time/locations, (ii) calculating digital signatures verifying the authenticity of the data including, for example, time and space information provided by the GPS receiver 700, GSU input data from input sources and sensors, and the UIC of the GSU chip, (iii) performing encryption and decryption functions on selected items of collected data, and (iv) performing other functions described hereinabove.

Aboard the GSU-enabled client network device, the GSU chip 175 periodically samples its input port for client input data (e.g. biophysiological, or other state data of the object or its ambient environment). In the case of not receiving any data at its input port, the GSU chip can be designed to automatically generate an UIC (or default) data element at each input sampling instant, and then use the data element for time-space stamping operations at that sampling instant. Notably, the use of a UIC-indicating data element serves to uniquely identify the corresponding GSU chip at each instance in time along the time-space continuum. In such embodiments, the UIC can be encrypted for added security measures. Then the GSU chip 175 generates a time and space stamp for each input sampling instant. The GSU chip uses digital signature techniques to create (i.e. compute) a digital signature for the set of data comprising: the UIC-indicating (or default) data element generated at each GSU sampling instant; and the time and location data of the GSU chip at the time of input data sampling within the GSU chip. Notably, the time of GSU input data sampling will be expressed in terms of a globally time-synchronized time measure derived by the GSU chip, whereas the location of the GSU at the instant of GSU input sampling would be expressed in terms of a globally referenced space/location measure derived by the GSU chip. The set of data and the computed digital signature applied thereto produces a digitally signed data package. The digitally signed data package is then sent over the network to the TS-stamping based tracking server 1000 to serve as a record of the time-space

trajectory point of the uniquely identified GSU chip, and associated object, at a particular instant in time. At a later time, this record can be used to prove that the GSU chip (and associated object) existed at the space-time coordinates indicated by the time-stamp contained within the digitally-signed data package received at the TS-stamping based tracking server 1000.

Web-Based Owner/Object Registration Information Server of the Present Invention

As shown in FIG. 16C, the Web-Based Owner/Object Registration Information Server 1003 comprises: a standard I/O 220; a high performance network interface 210; standard device drivers 280; and the operating system 240. These components cooperate to support the operation of the web server software 360. The web server software 360 consists of an HTTP daemon, along with various scripts and utility programs used to handle owner/object registration and to perform object tracking service updates as such information becomes available. Typically, the web server software 360 provides support for HTML, Java, and other standard protocols and web technologies.

As shown in FIG. 16C, a number of system components are used to distribute and present HTML (or XML) encoded documents (with or without Java or Active-X applets) and associated web content to the owners. Web-based Owner/Object Registration Servers 1003 shares a common networked Owner/Object RDBMS 1001 which contains registration and other information. In addition to providing the Owner/Object Registration WWW Site, the Owner/Object Registration Web Server 1003 also distributes the Owner/Object information management (OOIM) client software to Web-enabled client machines 1010 used by owners to monitor their registered objects. Such down loading operations can be carried out using the HTTP or FTP protocols. Before downloading OOIM client software, each owner is required to register on the Web-based Owner/Object Registration Server 1003. Registration involves filling out a web-based (e.g. HTML-encoded or XML-encoded) form containing the necessary personal and client machine information and submitting that form to the web server.

Web-Based Owner/Object Tracking Information Server of the Present Invention

As shown in FIG. 16B, the TS-Stamping Based Tracking Server 1000 employed in the system of FIG. 16, comprises a number of software and hardware components. As shown in FIG. 16B, the structure of the tracking server 1000 is described using the layered structure of a standard general

purpose computer, wherein the hardware components are shown at the lowest level, with successive layers of software functionality disposed above them. Each layer of components utilizes and builds upon the services and capabilities of the lower layers, most often only directly interfacing with the layer immediately below it. In the server, the low level hardware includes a GPS receiver 170, and high precision clock and timing hardware 200 synchronized to a global time reference using the GPS receiver. In addition, the high performance network interface hardware 210 is used to connect the server 1000 to the communications network 190. These hardware components are in addition to the standard I/O and other hardware 220 typically provided on a high-end network server, such as the SUN Enterprise™ server running the Solaris™ platform, by Sun Microsystems, Inc. of Palo Alto, California. Above the hardware level are standard and customized device drivers 230 that control and communicate directly with the hardware. The device drivers are used by the operating system 240 and higher-level applications so that direct hardware programming is not necessary. At the top level of FIG. 16B, an object-tracking related application, called the TS-tracking server daemon 242, is supported. This piece of software manages the sequence of operations for the TS-stamping based object tracking process as a whole, as well as managing the communication of collected time-space (TS) coordinate data between the tracking server 1000 and with the Owner/Object Registration RDBMS 1001, where such data is stored.

Owner/Object Record RDBMS of The Present Invention

In FIG. 18, a database table is shown for storing owner records, object property records, and object trajectory records. Owner records and object property records are created during the Owner/Object Registration Process described hereinabove using a Web-enabled client machine 1010 accessing the Owner/Object Registration Information server 1003. In general, such records can be changed at any time by the owner using the password assigned thereto at the time of initial registration. Owner records will generally contain information identifying the owner of one or more objects to be tracked by the system of the present invention, his or her address, and other contact information. In some instances, it may be desired for the owner to remain anonymous and therefore will register with an alias, or using a numeric or alphanumeric code assigned thereto by another Web-based information server, to maintain the privacy of the owner. Various sorts of techniques can be employed to protect the identity of the owner, in relation to particular objects being tracked, in various applications.

As shown in Fig. 18, each object property record is uniquely linked or related to a particular owner record in the RDBMS 1001 and typically will uniquely identify the object being tracked. Such object identification can be by way of a title assigned to the object by its owner, by a unique bar code symbol or other code assigned to the object by the owner or system administrator. Such object property records can also describe unique properties and characteristics of the object for insurance reasons, proof of ownership, and the like. Each object tracking record is uniquely linked or related to an object property record maintained within the RDBMS 1001, and in the illustrative embodiment, contains time-space coordinate data generated by a mobile GSU-enabled client-computing machine carried by the object being tracked by the system. During the object tracking process, TS-stamping data collected by the Object Tracking information server 1002 is automatically stored in the RDBMS 1001 in a linked relationship with its associated object record, as shown schematically in Fig. 18.

Web-Based Object Trajectory Monitoring Information Server Of The Present Invention

As shown in FIG. 16D, the Web-Based Object Trajectory Monitoring Information Server 1002 comprises: a standard I/O 220; a high performance network interface 210; standard device drivers 280; and the operating system 240. These components cooperate to support the operation of the web server software 360'' which serves up a Object Trajectory Monitoring WWW site accessible to registered owners using from any Web-enabled client machine 1010. As shown in Fig. 16D, the web server software 360" consists of an HTTP daemon, along with various scripts and utility programs used to handle object trajectory monitoring operations carried out in response to requests by owners as to the trajectory of a registered object over a period of time (i.e. position of the registered object plotted as a function of time), as illustrated in Figs. 17A and 17B. In order to respond to owner requests for object trajectory information, the Web-Based Object Trajectory Monitoring Information Server 1002 has network access to the Owner/Object RDBMS 1001 via a common gateway interface (CGI) or Java-servlet based interface to the RDBMS 1001. Typically, the web server software 360" provides support for HTML, Java, and other standard protocols and web technologies well known in the art.

As shown in FIG. 16D, a number of system components are used to distribute and present HTML (or XML) encoded documents (with or without Java or Active-X applets) and associated web content to the owners or custodians of objects registered with the system. Web-based Object Trajectory Monitoring information server 1002 communicates with the common networked

Owner/Object RDBMS 1001 which contains owner and object registration information as well as other object trajectory information (e.g. TS data). Also at the Object Trajectory Monitoring Web Site, owners of authorized custodians can download the Object Trajectory Monitoring (OTM) client software using HTTP or FTP protocols. Before downloading OTM client software, each owner is required to register on the web-based Object Trajectory Monitoring Information Server 1002. Registration involves filling out a web-based (e.g. HTML-encoded or XML-encoded) form containing the necessary personal and client machine information and submitting that form to the web server.

Communications Network Of The Object Tracking System of The Present Invention

The final component of system shown in FIG. 16 which deserves mention is the communications network 190. In general, the communications supported by the communications network 190 can be carried out using a variety of different communications methods. In general, each computer or device in the system will establish a connection or connections to one or more of the other computers through the network 190. In practice, these connections will be "virtual" connections through a general network such as the Internet, rather than as a direct point-to-point physical connection. In the illustrative embodiments disclosed herein, the communications network 190 is a packet-switched data communications network running the popular Transmission Control Protocol/Internet Protocol (TCP/IP). Thus each server computer connected to the communications network 190 will have a statically assigned IP address, while each client machine connected thereto will have either a statically or dynamically assigned IP address in a manner well known in the art.

Three Basic Modes of System Operation: Owner/Object Registration, Object Tracking & Object Monitoring

In general, the object tracking system of the present invention has three primary modes of operation, namely: owner/object registration mode; object tracking mode; and object trajectory monitoring mode. Each of these modes of operation will be described below.

Owner/Object Registration Process of The Present Invention

During the owner/object registration mode, the owner of an object to be tracked by the system would first obtain a GSU-enabled client network device that is compatible with the particular TS-stamping based object tracking service

to be used in the case at hand. In practice, each GSU-enabled client network device could be realized as the size of a conventional beeper or pager, but ideally smaller and lighter for attachment to various types of objects without causing an inconvenience. The form factor in which the housing of the device is realized will depend on the application at hand.

For example, in the shipping industry, it might be desirable to realize the GSU-enabled client computing/network device as a wireless, ultra-low profile security tag affixed to a package in a tamper-indicating manner so that once affixed to the package, and registered with the web-based object tracking system, the GSU-enabled device will automatically generate an "device is being tampered with or removed from package" message at the input of the GSU chip 175, which will be received by the TS-Stamping Based Tracking Server 1000, causing the generation of an alarm message with respect to the object/owner associated with the shipped package. It is understood that while the shipper who affixed the wireless GSU tracking device to the package may not be the owner of the package, this entity may nevertheless be treated as such for purposes of administrating the Web-based object tracking service(s) of the present invention.

In general, there are many ways in which to generate data inputs at the GSU's input port indicating that "the device is being tampered with or removed from its package". Such data message generation methods can be based on electrical, mechanical-electrical, acoustical-electrical, and optical-electrical principles well known in the security arts. One such mechanism might involve encasing the GSU chip and supporting platform within a device package having a spring-biased surface-sensing pin projecting from the mounting surface of the device. The surface-sensing pin would be constructed so that it retracts when pushed against the surface of the package to which the GSU-enabled device is to be mounted, and automatically projects out therefrom when the device is removed from the package's mounting surface, automatically generating a binary signal at the input port of the GSU chip.

During the registration process, the GSU-enabled device would be affixed to the package, setting the surface-sensing pin within the device at an appropriate time. Then, when the device is removed from the package, by either an authorized or unauthorized person, the tracking system will automatically detect this event and inform the package's owner or shipper, depending on the particular application/service being carried out. Expectedly, such GSU-enabled tags will have many other applications across diverse industries requiring the information collection/detection functionalities of the present invention.

Having acquired a GSU-enabled client network device, the owner or agent thereof uses a web-enabled client machine to log-on to the Owner/Object

Registration Information server 1003 and register himself and one or more objects to be tracked by the Object Trajectory Tracking information server 1002. The registration process will typically involve filling out HTML-encoded forms and sending them back to the server for processing. During processing of such completed forms, the Owner/Object Registration Information server 1003 creates in the Owner/Object Registration Database (i.e. RDBMS) 1001, a data record for the owner of each object to be registered with the system, as well as for each such object, including the UIC assigned to the GSU chip to be used to track and monitor the time and space trajectory thereof.

Object Tracking Process of The Present Invention

Once a GSU-enabled client network device has been attached to a registered object, and the registration process has been completed, the TS-stamping based object tracking server 1000 will attempt to communicate with the wireless GSU-enabled client network device over the wireless IP-based packet switching network of the system. Once a connection has been established, the TS-stamping based object tracking server 1000 will perform all sorts of diagnostic checks to see that the wireless GSU-enabled network device is operating properly. Such checks will typically include (i) TS data collection and transmission by the GSU chip, (ii) battery-power level monitoring using battery-power level monitoring module 305, as well as (iii) other diagnostic checks aboard the wireless network device. Typically, the results of such diagnostic tests will be posted for review by the owner at the Object Trajectory Monitoring WWW Site served by the Web-based Object Trajectory Monitoring information server 1002. Notably, the owner will have to log-on to this site by password, or can be immediately switched over thereto from the Owner/Object Registration WWW Site served by the Web-based Owner/Object Registration information server 1003.

Once all systems are determined to be working properly, the time and space coordinates of the GSU-enabled client network device carried on the owner's object will be automatically tracked every input sampling period within the GSU chip thereof, as described hereinabove. Periodically, the GSU-enabled client network device will monitor the battery power level of its battery power supply and send information representative of this system state to the TS-Stamping Based Tracking Server 1000.

During mobile object tracking processes, the time-space coordinates of the GSU-enabled client network device are automatically collected by the TS-Stamping Based Tracking Server 1000. FIG. 17A shows an exemplary locus of TS

data collected by the system while the object being tracked is transported through space.

During the object movement detection processes, the TS-Stamping Based Tracking Server 1000 will collect TS data samples having substantially the same space coordinates, indicating that the object has not been moved from its location registered with the system (i.e. via data stored in the Owner/Object RDBMS 1001). When the object is moved from this registered location, either by authorized or unauthorized personnel, the TS-Stamping Based Tracking Server 1000 will collect TS data samples having space coordinates that fall outside the registered location, as indicated in FIG. 17B. Data processing algorithms can be used to process TS data within the Owner/Object RDBMS 1001 to detect such object motion or movement. Also, using knowledge of the data input sampling rate (T_s) within each GSU chip, the instantaneous velocity of the object (v_x) between pairs of position locations along the x axis of the coordinate system (x1 and x2) can be readily computed using the formula $v_x = [x1 - x2] T_s$. Similarly, the instantaneous velocity of the object along the y and z axis can also be computed similar formulas known in the art. Such computed velocity measures can be stored in the Owner/Object RDBMS 1001 and visually displayed on the Web-Based Object Trajectory Monitoring WWW Site for viewing by the object's owner logged thereon using password protection.

Object Monitoring Process of The Present Invention

Each object owner can log-on to the Object Trajectory Monitoring WWW Site and monitor the trajectory of any one of his or her registered objects. Such monitoring operations are carried out using any Web-enabled client machine 1010 pointing to the URL at which the Object Trajectory Monitoring WWW Site is located. During trajectory monitoring operations, the Object Trajectory Monitoring Server 1002 accessed information stored in the Owner/Object RDBMS 1001. While the TS-Stamping Tracking Server 1000 tracks GSU's in terms of its assigned UIC, each owner can his or her object using the name/title that the owner has assigned to the object.

Applications of The TS-Stamping Based Object Tracking System Of The Present Invention

The object tracking system described above can be modified to perform biophysiological data collection as well as TS data collection. This system modification will be useful in applications where vital characteristics of living things (e.g. humans and animals) are to be monitored in real-time, in addition to

tracking the time and space coordinates thereof. This system is achieved by replacing the GSU-enabled client network device shown in FIG. 16A with the GSU-enabled client network device shown in FIGS. 19A and 19B. As shown, GSU-enabled client network device 160'' includes a biophysiological data sensor (e.g. pulse sensor, EKG sensor, or other biophysiological signal sensor) 309, as well as all other subcomponents contained in the GSU-enabled client network device shown in FIG. 16A. Also, the system in FIG. 16 is further modified by replacing TS-Stamping Tracking Server 1000 shown in FIG. 16B with the TSB-Stamping Tracking Server 1007 shown in FIG. 20 which is capable of receiving and decrypting biophysiological data as well as TS data contained within each digitally-signed data package transmitted by the GSU-enabled client network device 175". Also, the Owner/Object RDBMS 1001 specified by the table in FIG. 18 is replaced by the Owner/Object RDBMS 1001 specified by the table in FIG. 22.

Owner and object registration with this modified system can be carried out in substantially the same manner as carried out in the system of FIG. 16. schematic representation of an exemplary locus of time, space and biophysiological coordinates collected by the time, space and biophysiological (TSB) stamping based tracking server shown in FIG. 16 during the process of tracking a living being carrying the GSU-enabled client device of FIGS. 19A and 19B in accordance with the principles of the present invention.

During the process of tracking a living being carrying the GSU-enabled client device of FIGS. 19A and 19B, digitally-signed TSB data packages are periodically transmitted by the GSU-enabled client network device 160" to the TSB-Stamping Based Tracking Server 1007. FIG. 21 shows an exemplary TSB trajectory plot for an object being tracked by the system and monitored from the Web-based Object Trajectory Monitoring WWW Site. The TSB data associated with the TSB trajectory plot is stored within the Owner/Object RDBMS shown in Fig. 22.

Data processing algorithms can be used to analyze the TSB data table to automatically detect changes in the biophysiological data stream which indicate changes in vital signs of the living being tracked/monitored. Such changes in biophysiological data can be graphed and viewed by the owners/custodians of the corresponding object using a Web-enabled client machine pointing to the Web-based Object Trajectory Monitoring WWW site.

Alternative Applications For The Internet-based TS-Stamping Object Tracking System and Method Of The Present Invention

The Internet-based TS-stamping object tracking system and method described in great detail above can be readily modified to provide a wide range of useful systems capable of supporting a wide range of novel services deliverable over the Internet. The downloading of service-specific client software and service registration and monitoring operations carried out using conventional Web browser technology in a manner similar to that described hereinabove. Referring to Figs. 23A through 29B, seven different Internet-based systems and methods will now be described below.

In Fig. 23A, a schematic description is provided for an Internet-based method of and system for securing a region of physical space, indicated in the TS tractory diagram of Fig. 23B. In this system, a GSU-enabled client network device 160' is provided with a CCD-based digital video camera or scanner for capturing images of a field of view (FOV) of the camera or scanner, and a sound recording device for recording sound (tracks) within and about the field of view (FOV) of the camera. Each captured image frame is accurately space-time stamped, and recorded on videotape or other digital recording medium associated with image RDBMS 1001'. Web-based owner/device registration server 1003' is provided for registering owners (or custodians) of GSU-enabled devices 160' within the RDBMS 1001', with other data contained therein. A Web-based image monitoring server 1002' is provided for allowing owners to view image/sound frames captured and stored in the RDBMS 1001'. Web-enabled client machines 1010' are provided for carrying out such owner involved operations.

Fig. 23B shows a data table describing the information fields maintained in the Image RDBMS employed in the system of Fig. 23A, wherein TS-stamped images and associated sound recording tracks are stored for analysis and usage in various security operations.

In Fig. 24A, a schematic description is provided for an Internet-based method of and system for securing a computer communications network by embodying a GSU chip 175 into each network computing device 160' so that its access to a particular communications/computer network (i.e. subnetwork) or WWW site can be securely enabled by a TS-stamping tracking server 1001' only upon the generation of a unique time-space stamp by the GSU-chip 175. This is achieved when the GSU-enabled network computing device is physically present at a predetermined location over a particular time interval. A Web-based owner/device registration server 1003' is provided for registering owners (or custodians) of GSU-enabled devices 160' within the RDBMS 1001'. A Web-based Network access monitoring server 1002' is provided for allowing owners to

monitor network access enabled by the system. Web-enabled client machines 1010' are provided for carrying out such owner involved operations.

Fig. 24B provides a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 24A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to access a prespecified communication subnetwork or WW server in accordance with the principles of the present invention.

In Fig. 25A, a schematic description is provided for an Internet-based method of and system for securing a computers communications network by embodying a GSU chip 175, wherein a GSU-enabled network computing device 160' which is used to access a particular communications (sub)network or WWW site, is partially enabled by the enabled the TS-stamping tracking server 1001' when the GSU-enabled network computing device 160' is present outside of the predetermined location, or predetermined time interval, so that the TS-stamping tracking server can track to the exact location of the GSU-enabled computing device 160' and authorities can apprehend the person using the same without authorization. A Web-based GSU-enabled client computing device/owner registration server 1003' is provided for registering owners (or custodians) of GSU-enabled devices 160' within the RDBMS 1001'. A Web-based device trajectory monitoring server 1002' is provided for allowing owners to monitor TS trajectory of each registered network computing device 160', and to determine when and where encrypted messages have been decrypted and displayed by the device. Web-enabled client machines 1010' are provided for carrying out such owner involved operations.

Fig. 25B shows a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 25A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to decrypt and display encrypted message prestored on the GSU-enabled network computing device in accordance with the principles of the present invention.

In Fig. 26A, a schematic description is provided for an Internet-based method and system for enabling "location-and time" based decryption of messages by using a GSU-enabled client computing device 160' which is enabled by a TS-stamping tracking server 1001' to decrypt certain messages stored on a computer network only at certain times/places (i.e. ranges of TS coordinate data), and at no others, for reasons that need only be known to the author of such messages. A Web-based GSU-enabled client computing device/owner

registration server 1003' is provided for registering owners (or custodians) of GSU-enabled devices 160' within the RDBMS 1001'. A Web-based device trajectory monitoring server 1002' is provided for allowing owners to monitor TS trajectory of each registered network computing device 160', and to determine when and where received encrypted radio messages have been decrypted and visually or sonically displayed by the device. Web-enabled client machines 1010' are provided for carrying out such owner involved operations.

Fig. 26B shows a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 26A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server 1001' to decrypt and display encrypted radio messages being received by the GSU-enabled network computing device in accordance with the principles of the present invention.

In Fig. 27A, a schematic description is provided for an Internet-based method of and system for displaying information clues or instructions at particular instances along the space-time continuum. In the system, a wireless GSU-enabled client network device 160' (realized for example in the form of a watch or other portable casing having an integrated display screen and keypad) cooperates with a TS-stamping based tracking server 1001' through a global communication network (i.e. the Internet) so as to enable the GSU-enabled client network device to display information clues and/or instructions only when the GSU-enabled device 160' is present within specific location over a particular time interval (i.e. intersects a prespecified region along the space-time continuum). A Web-based GSU-enabled client computing device/owner registration server 1003' is provided for registering owners (or custodians) of GSU-enabled devices 160' within the RDBMS 1001'. A Web-based display monitoring server 1002' is provided for allowing owners to the display of each registered network computing device, and to determine when and where received encrypted messages have been decrypted and visually or sonically displayed by the device. Web-enabled client machines 1010' are provided for carrying out such owner involved operations.

In Fig. 27B, shows a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 27A, and the predetermined TS-region over which the GSU-enabled network computing device is enabled by the TS-Stamping Based Tracking Server to decrypt and display encrypted messages prestored in memory in the GSU-enabled network computing device in accordance with the principles of the present invention.

Fig. 28A shows a schematic representation of an Internet-based method of and system for enabling the operation of set-top cable television boxes 160', and other digital media content delivery devices, in compliance with license agreements, wherein a GSU-enabled network computing device 160' is embedded within each set-top cable television box, and other digital media content delivery device, in a media content delivery system, and one or more TS-stamping based tracking servers 1001' are used to track and control such media content delivery devices so that the media content delivery devices are enabled into operation only when such devices are in fact used in accordance with the conditions of use set forth in the license agreement with the customer (i.e. when used within the particular location specified in the license agreement and during the time duration thereof). A Web-based GSU-enabled client computing device/owner registration server 1003' is provided for registering owners (or custodians) of GSU-enabled devices 160' within the RDBMS 1001'. A Web-based device trajectory monitoring server 1002' is provided for allowing owners to monitor TS trajectory of each registered media content delivering device, and determine when and where each registered device has been enabled for operation. Web-enabled client machines 1010' are provided for carrying out such owner involved operations.

Fig. 28B provides a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 28A, and the predetermined TS-region over which the GSU-enabled media content delivery device is enabled operational by the TS-Stamping Based Tracking Server in accordance with the principles of the present invention.

In Fig. 29A, a schematic description is provided for an Internet-based method of and system for enabling/controlling the operation any portable host system or device which is restricted to operate within a set of space-time constraints, by embedding a GSU-enabled device 160' within each such portable host system or device, and using one or more TS-stamping based tracking servers 1001' to track and enable the operation of each such portable host system or device only when such systems and devices are in fact used in accordance with the conditions of use set forth in the license agreement.

Fig. 29B provides a schematic representation of an exemplary locus of time-space coordinates collected by the TS-Stamping Based Tracking Server of the system of FIG. 29A, and the predetermined TS-region over which the GSU-enabled media content delivery device is rendered operational by the TS-stamping based tracking server, in accordance with the principles of the present invention.

Alternative Applications For GSU of The Present Invention

There are many possible configurations for retrieving and using the information produced by the GSU of the present invention. In the real-time object tracking system detailed above, each GSU-enabled device transmitted digitally-signed TS (and TSB) containing data packages to the TS-stamping (and TSB-stamping) based Tracking Server 1000 (1007) after each sampling of TS coordinates carried out within the GSU chip within the GSU-enabled device. It is understood, however, that in particular applications, it be desirable to buffer large or small sets of TS coordinate data aboard the device and then periodically downloaded the same to the tracking server, eliminating the amount of time that the client network device has to be on-line. In some applications, the entire TS trajectory of the client network device for a particular time interval (e.g. hour, day, week or month) can be buffered in data storage aboard the GSU-enabled client device and downloaded at a predetermined time to the tracking server, or other computer for processing and eventual display.

While a wireless communication link has been described for linking each mobile GSU-enabled client network device 160' with the TS-stamping based tracking server, it is understood that in other applications of the present invention, it might be desirable to use types of communications links and protocols, such as the "BlueTooth" protocol for local access, or a physical connector, or remote access through wired or wireless networking.

While it would be preferred to integrate the GSU, CPU and data storage structures aboard the GSU-enabled client network device as a single integrated circuit (IC) chip, it is understood that the GSU-enabled client network device can be realized as a separate GSU interfaced with its associated client computer.

While the GSU-enabled client network device of the illustrative embodiment has been provided with one or more biophysiological sensors, to enable remote monitoring of the vital signs of a living object being tracked, it is understood that other types of sensors and inputs could provided to the GSUs of such devices in order to perform additional functionalities. Such sensors and input devices may include, for example: temperature sensors, humidity sensors, light level sensors, chemical sensors, and other physical property sensors, CCD image capturing devices, sound sensing/pickup and recording devices, fingerprint sensing/detection devices and other biometric sensing devices, vibration sensors, radiation sensors, gas/vapor sensors, speech recognition devices, keypad input devices, graphics input devices, devices for detecting

tampering of the GSU-enabled device and/or removal of the GSU from its associated object, and the like.

Another use for the GSU of the present invention would be in security applications. In such a contemplated application, the GSU-enabled client network device includes a CCD-based digital video camera or scanners for capturing images of a field of view of the camera or scanner, as well as an sound recording device for recording sound within and about the field of view of the camera. Each captured image frame would be accurately space-time stamped, and recorded on videotape or other digital recording medium. Tamper-proof manufacturing of the GSU-enabled digital camera insures accuracy of captured image data. A unique serial number can be encrypted in bash on video tape or digital document. The use of a random sampling rate for video and audio can insure that live action will be filmed

The GSU-enabled client network device of the present invention can be used for ensuring security in computers communications networks by requiring that the GSU-enabled network device generate a unique time-space stamp for entry into a particular communications network. In such an application, a user would be provided access to a particular communications network only if the user accesses the network using a GSU-enabled client computing/network device (having keyboard and mouse input and a display screen) that is physically present at a particular location in space, at a particular internal in time. This application enables the creation of an audit trail that shows place and time of use of the GSU-enabled computing device. Also, it has the potential to lock out stolen GSU-enabled devices, or, if desired, allow limited access to the network only to track to the exact location of the device and apprehend the theft using the stolen or authorized computing device.

Another application for the GSU-enabled client computing device of the present invention is to enable "location-and time" based decryption of messages so that certain messages stored on a computer network can be decrypted at certain times/places, and at no others, for a particular reason know to the author of the message.

Another application for the GSU-enabled client computing device of the present invention is to enable the embedding of a message within a transportable GSU-enabled computing device so that the message can only be decrypted in a specific location at a specific time period.

Another application for the GSU-enabled client computing device of the present invention is to enable secure radio communications by restricting that only specific GSU-enabled client network device, equipped with radio

communications capabilities, can decrypt a particular radio message at a particular location at a particular period of time.

Another application for the GSU-enabled client network device of the present invention would be to provide wireless GSU-enabled client network device in the form of a watch having a display screen and keypad which can be used to play a scavenger-hunt and like game. In such a contemplated application, the user of the device obtains clues from the GSU-enabled wrist watch only when he or she is within specific location. There can be multiple start points, multiple paths to finish, and variable paths based upon the time the user arrives at the clue locations.

Similarly, such a wireless GSU-enabled network device, without a display screen or keypad input, can be affixed (i.e. strapped) to the body of a human athlete (e.g. skier, runner or swimmer) or animal participating in sports competition. During a competition, TD data is collected from the GSU-enabled device carried by the athlete on a real-time basis (using a TS-stamping based tracking server) as the athlete travels from point to point, along a predetermined course. The collected TS data can be remotely analyzed to determine the performance of the athlete in the competition and determination of a winner.

Another application for the GSU-enabled network device of the present invention is to embed a GSU-enabled device within each set-top cable television box, or other digital media content delivery device, in a media content delivery system. Then, using one or more TS-stamping based tracking servers, the GSU-enabled digital content media delivery devices are enabled into operation only when such devices are in fact used in accordance with the conditions of use set forth in the license agreement with the customer (i.e. when used within the particular location specified in the license agreement and during the time duration thereof). By virtue of the present invention, it is now possible to enforce strict compliance of license agreements relating to the use of media content delivery devices and services involving use of the same.

Another application for the GSU-enabled network device of the present invention is to embed a GSU-enabled device within any portable host system or device which is restricted to operate within a set of space-time constraints. In such instances, in addition to TS data tracking, the TS-stamping based tracking server of such a system will also enable or otherwise control particular functions within the host system or device based on its time-space coordinates.

While the illustrative embodiments of the present invention have been described with regard to the Internet, it is understood that the systems and methods of the present invention can also be carried out on public as well as private intranets, owned, managed, or otherwise used by large or small business

and/or social organizations of either national or international extent, having members scattered across the globe.

It is understood that the Internet-based system and subsystems and components of the present invention may be modified in a variety of ways which will become readily apparent to those skilled in the art of having the benefit of the novel teachings disclosed herein. All such modifications and variations of the illustrative embodiments thereof shall be deemed to be within the scope and spirit of the present invention as defined by the Claims to Invention appended hereto.

WHAT IS CLAIMED IS:

1. A global synchronization unit (GSU) for time and space (TS) stamping of input data elements, said GSU comprising:

a GPS Receiver and an associated antenna for receiving GPS signals from signal sources associated with a GPS system symbolically embedded within a global reference system, and processing said received GPS signals so as to automatically produce time and space (TS) stamp data element representative of the time and space coordinates of said GSU with respect to said global reference system at each data sampling instant occurring within said GSU; and

a central processor, operably connected to said GPS Receiver; and

a data input port, operably connected to a data input device and said central processor, for receiving an input data element from said data input device, at each said data sampling instant;

wherein said central processor (i) connects the input data element received at said data input port at each said data sampling instant, with the TS-stamp data element generated at said sampling instant so as to produce a TS-stamped input data element, and (ii) stores each said TS-stamped input data element in memory.

2. The GSU of claim 1, wherein said memory is disposed within said GSU.

3. The GSU of claim 1, wherein said GPS Receiver receives said GPS signals from GPS satellites, and said GPS satellites receive time signals derived from an atomic clock.

4. The GSU of claim 1, wherein said data input device is a device selected from the group consisting of a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, biometric sensor, biophysiological sensor, and any other analog or digital data input device.

5. The GSU of claim 1, wherein said data input device is a device selected from the group consisting of water level sensors, burglar alarms, police radar devices, still image cameras, video cameras, microphones, and chemical sensors, bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, and optical sensors for race finish lines.

6. The GSU of claim 1, which further comprises a data output port for outputting said TS-stamped input data elements stored in said memory to a data output device operably connected to said data output port.

7. The GSU of claim 6, wherein said data output port comprises hardware and communication protocols to enable communication between said central processor and said data output device.

8. The GSU of claim 1, wherein said central processor further (iii) accesses said TS-stamped input data elements from said memory and transmits the accessed TS-stamped input data elements through said data output port to said data output device.

9. The GSU of claim 1, wherein each said input data element being representative of an event occurring outside of said GSU.

10. The GSU of claim 1, wherein said central processor further performs encryption functions on each said input data element contained within said TS-stamped input data element.

11. The GSU of claim 1, wherein said central processor further performs encryption functions on each said TS-stamped input data element.

12. The GSU of claim 11, wherein said central processor further calculates a digital signature for each said TS-stamped input data element and connects said digital signature to said TS-stamped input data element to produce a digitally-signed TS-stamped input data element which enables the verification of authenticity of the data contained in said TS-stamped input data element, at some remote location.

13. The GSU of claim 12, wherein said central processor further performs encryption functions on said digitally-signed TS-stamped input data element.

14. The GSU of claim 1, wherein said data input device is a device selected from the group consisting of a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, biometric sensor, biophysiological sensor, and any other analog or digital data input device.

15. The GSU of claim 1, wherein said data input device is a device selected from the group consisting of water level sensors, burglar alarms, police radar devices, still image cameras, video cameras, microphones, and chemical sensors, bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, and optical sensors for race finish lines.

16. The GSU of claim 1, wherein said GSU is realized in the form of an integrated circuit (IC) chip.

17. The GSU of claim 1, wherein said IC chip is an Application Specific Integrated Circuit (ASIC) device.

18. A global synchronization unit (GSU) for decrypting an encrypted data element into a decrypted input data element and performing a predetermined function thereupon in response to the generation of time and space (TS) triggering coordinates within said GSU, said GSU comprising:

a GPS Receiver and an associated antenna for receiving GPS signals from signal sources associated with a GPS system symbolically embedded within a global reference system, and processing said received GPS signals so as to automatically produce time and space (TS) stamp data element representative of the time and space (TS) coordinates of said GSU within said global reference system at each data sampling instant occurring within said GSU; and

a central processor, operably connected to said GPS Receiver; and

a data input port, operably connected to a data input device and said central processor, for receiving an encrypted input data element and function triggering data from a data input device, and storing said encrypted input data element and said function triggering data in non-volatile memory,

wherein said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted data element into a decrypted input data element, and (ii) perform a predetermined function upon said decrypted input data element, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted data element into a decrypted input data element, and (ii) performs said predetermined function upon said decrypted input data element.

19. The GSU of claim 18, wherein said non-volatile memory is disposed within said GSU.

20. The GSU of claim 18, wherein said GPS Receiver receives said GPS signals from GPS satellites, and said GPS satellites receive time signals derived from an atomic clock.

21. The GSU of claim 18, wherein said data input device is a device selected from the group consisting of a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, biometric sensor, biophysiological sensor, and any other analog or digital data input device.

22. The GSU of claim 18, wherein said data input device is a device is selected from the group consisting of water level sensors, burglar alarms, police radar devices, still image cameras, video cameras, microphones, and chemical sensors, bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, and optical sensors for race finish lines.

23. The GSU of claim 18, which further comprises an output data port for outputting said TS-stamped input data elements stored in said non-volatile memory to a data output device operably connected to said data output port.

24. The GSU of claim 23, wherein said central processor further (iii) accesses said TS-stamped input data elements from said non-volatile memory and transmits the accessed TS-stamped input data elements through said data output port to said data output device.

25. The GSU of claim 1, wherein said encrypted input data element is an encrypted image data set to be displayed by said data output device and said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted input image into a decrypted image data set, and (ii) transmit said decrypted image data set through said data output port to said data output device for display, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted image data set into said decrypted image data set, and (ii) transmits said decrypted image data set through said data output port to said data output device for display.

26. The GSU of claim 18, wherein said data input port comprises hardware and communication protocols to enable communication between said central processor and said data input device.

27. The GSU of claim 23, wherein said data output port comprises hardware and communication protocols to enable communication between said central processor and said data output device.

28. The GSU of claim 18, wherein said GSU is realized in the form of an integrated circuit (IC) chip.

29. The GSU of claim 18, wherein said IC chip is an Application Specific Integrated Circuit (ASIC) device.

30. A global synchronization unit (GSU) for use with a host computing device, said GSU comprising:

a GPS Receiver and an associated antenna for receiving GPS signals from signal sources associated with a GPS system symbolically embedded within a global reference system, and processing said received GPS signals so as to automatically produce time and space (TS) stamp data element representative of the time and space coordinates of said GSU with respect to said global reference system at each data sampling instant occurring within said GSU; and

a central processor, operably connected to said GPS Receiver, and having a host computer interface for receiving an input data element from said host computing device, at each said data sampling instant, and

wherein said central processor (i) connects the input data element received at said host computer interface at each said sampling instant, with the TS-stamp data element generated at said data sampling instant so as to produce a TS-stamped input data element, and (ii) stores each said TS-stamped input data element in memory.

31. The GSU of claim 30, wherein said memory is disposed within said GSU.

32. The GSU of claim 30, wherein said memory is disposed within said host computing device.

33. The GSU of claim 30, wherein said GPS Receiver receives said GPS signals from GPS satellites, and said GPS satellites receive time signals derived from an atomic clock.

34. The GSU of claim 30, wherein said central processor further (iii) accesses said TS-stamped input data elements from said memory disposed within said GSU and transmits the accessed TS-stamped input data elements through said host computer interface to said host computing device.

35. The GSU of claim 30, wherein each said input data element being representative of an event occurring outside of said GSU.

36. The GSU of claim 30, wherein said central processor further performs encryption functions on each said input data element contained within said TS-stamped input data element.

37. The GSU of claim 30, wherein said central processor further performs encryption functions on each said TS-stamped input data element.

38. The GSU of claim 30, wherein said central processor further calculates a digital signature for each said TS-stamped input data element and connects said digital signature to said TS-stamped input data element to produce a digitally-signed TS-stamped input data element which enables the verification of authenticity of the data contained in said TS-stamped input data element, at some remote location.

39. The GSU of claim 38, wherein said central processor further performs encryption functions on said digitally-signed TS-stamped input data element.

40. The GSU of claim 30, wherein said host computer interface comprises hardware and communication protocols to enable communication between said central processor and said host computing device.

41. The GSU of claim 30, wherein said host computer interface conforms to standard interface specifications selected from the group consisting of bus-based connections such as ISA, SCSI, and PCI; port-based connections such as USB, RS232, and PCMCIA; and wireless communication methods such as infrared and radio frequency links.

42. The GSU of claim 30, wherein said host computing device further comprises a network communications interface to an information network.

43. The GSU of claim 42, wherein the network communications interface is realized a wireless communication method.

44. The GSU of claim 30, wherein said GSU is realized in the form of an integrated circuit (IC) chip.

45. The GSU of claim 44, wherein said IC chip is an Application Specific Integrated Circuit (ASIC) device.

46. The GSU of claim 30, wherein said GSU and said host computing device are realized in the form of an Application Specific Integrated Circuit (ASIC) device.

47. A GSU-enable client computing device comprising said GSU and said client computing device of claim 30.

48. The GSU-enabled client computing device of claim 30, wherein said client computing device has a data input device for producing said input data elements, and wherein said data input device is selected from the group consisting of a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, biometric sensor, biophysiological sensor, and any other analog or digital data input device.

49. The GSU-enabled client computing device of claim 30, wherein said client computing device has a data input device for producing said input data elements, and wherein said data input device is selected from the group consisting of water level sensors, burglar alarms, police radar devices, still image cameras, video cameras, microphones, and chemical sensors, bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, and optical sensors for race finish lines.

50. A global synchronization unit (GSU) for use with a host computing device said GSU comprising:

a GPS Receiver and an associated antenna for receiving GPS signals from signal sources associated with a GPS system symbolically embedded within a global reference system, and processing said received GPS signals so as to automatically produce time and space (TS) stamp data element representative of the time and space coordinates of said GSU within said global reference system at each data sampling instant occurring within said GSU; and

a central processor, operably connected to said GPS Receiver, and having a host computer interface for receiving, through said host computer interface, an encrypted input data element and function triggering data from said host computing device, and storing said encrypted input data element and said function triggering data in non-volatile memory,

wherein said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted data element into a decrypted input data element, and (ii) perform a predetermined function upon said decrypted input data element, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted data element into a decrypted input data element, and (ii) performs said predetermined function upon said decrypted input data element.

51. The GSU of claim 50, wherein said non-volatile memory is disposed within said GSU.

52. The GSU of claim 50, wherein said GPS Receiver receives said GPS signals from GPS satellites, and said GPS satellites receive time signals derived from an atomic clock.

53. The GSU of claim 50, wherein said encrypted input data element is an encrypted image data set to be displayed by said client computing device and said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted input image into a decrypted image data set, and (ii) transmit said decrypted image data set through said host computer interface to said host computing device for display, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted image data set into said decrypted image data set, and (ii) transmits said decrypted image data set through said host computer interface to said host computing device for display.

54. The GSU of claim 50, wherein said host computer interface comprises hardware and communication protocols to enable communication between said central processor and said host computing device.

55. The GSU of claim 50, wherein said host computer interface conforms to standard interface specifications selected from the group consisting of bus-based connections such as ISA, SCSI, and PCI; port-based connections such as USB, RS232, and PCMCIA; and wireless communication methods such as infrared and radio frequency links.

56. The GSU of claim 50, wherein said host computing device further comprises a network communications interface to an information network.

57. The GSU of claim 56, wherein the network communications interface is realized a wireless communication method.

58. The GSU of claim 50, wherein said GSU is realized in the form of an integrated circuit (IC) chip.

59. The GSU of claim 50, wherein said IC chip is an Application Specific Integrated Circuit (ASIC) device.

60. The GSU of claim 50, wherein said GSU and said host computing device are realized in the form of an Application Specific Integrated Circuit (ASIC) device.

61. A GSU-enable client computing device comprising said GSU and said client computing device of claim 50.

62. The GSU-enabled client computing device of claim 61, wherein said client computing device has a data input device for producing said input data elements, and wherein said data input device is selected from the group consisting of a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, biometric sensor, biophysiological sensor, and any other analog or digital data input device.

63. The GSU-enabled client computing device of claim 61, wherein said client computing device has a data input device for producing said input data elements, and wherein said data input device is selected from the group consisting of water level sensors, burglar alarms, police radar devices, still image cameras, video cameras, microphones, and chemical sensors, bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, and optical sensors for race finish lines.

64. A global synchronization unit (GSU) for use with a host computing device having a network interface for connecting to a GPS-enabled information server on an information network, wherein said GPS-enabled information server includes (1) a GPS receiver and associated antenna for receiving GPS signals from signal sources associated with a GPS system symbolically embedded within a global reference system, and processing said received GPS signals so as to automatically produce time and space (TS) stamp data element representative of the time and space coordinates of said GPS-enabled information server with respect to said global reference system at each data sampling instant occurring within said GPS-enabled information server, and (2) a network interface for transmitting data elements to and receiving data elements from said host computing device over said information network, said GSU comprising:

a GPS Receiver and an associated antenna for receiving GPS signals from signal sources associated with a GPS system symbolically embedded within a global reference system, and processing said received GPS signals so as to automatically produce time and space (TS) stamp data element representative of the time and space coordinates of said GSU within said global reference system at each data sampling instant occurring within said GSU; and

a central processor, operably connected to said GPS Receiver, and having a host computer interface for receiving through said host computing device, at each said data sampling instant, an encrypted input data element and function triggering data from said GPS-enabled information server through said host computing device, and storing said encrypted input data element and said function triggering data in non-volatile memory,

wherein said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted data element into a decrypted input data element, and (ii) perform a predetermined function upon said decrypted input data element, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted data element into a decrypted input data element, and (ii) performs said predetermined function upon said decrypted input data element.

65. The GSU of claim 64, wherein said non-volatile memory is disposed within said GSU.

66. The GSU of claim 64, wherein said GPS Receiver receives said GPS signals from GPS satellites, and said GPS satellites receive time signals derived from an atomic clock.

67. The GSU of claim 64, wherein said encrypted input data element is an encrypted image data set to be displayed by said client computing device and said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted input image into a decrypted image data set, and (ii) transmit said decrypted image data set through said host computer interface to said host computing device for display, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted image data set into said decrypted image data set, and (ii) transmits said decrypted image data set through said host computer interface to said host computing device for display.

68. The GSU of claim 64, wherein said host computer interface comprises hardware and communication protocols to enable communication between said central processor and said host computing device.

69. The GSU of claim 64, wherein said host computer interface conforms to standard interface specifications selected from the group consisting of bus-based connections such as ISA, SCSI, and PCI; port-based connections such as USB, RS232, and PCMCIA; and wireless communication methods such as infrared and radio frequency links.

70. The GSU of claim 64, wherein said host computing device further comprises a network communications interface to an information network.

71. The GSU of claim 70, wherein the network communications interface is realized a wireless communication method.

72. The GSU of claim 64, wherein said GSU is realized in the form of an integrated circuit (IC) chip.

73. The GSU of claim 64, wherein said IC chip is an Application Specific Integrated Circuit (ASIC) device.

74. The GSU of claim 64, wherein said GSU and said host computing device are realized in the form of an Application Specific Integrated Circuit (ASIC) device.

75. A GSU-enable client computing device comprising said GSU and said client computing device of claim 64.

76. The GSU-enabled client computing device of claim 75, wherein said client computing device has a data input device for producing said input data elements, and wherein said data input device is selected from the group consisting of a mouse, keyboard, microphone, video camera, scanner, barcode reader, pressure tablet, a voice recognition system, biometric sensor, biophysiological sensor, and any other analog or digital data input device.

77. The GSU-enabled client computing device of claim 75, wherein said client computing device has a data input device for producing said input data elements, and wherein said data input device is selected from the group consisting of water level sensors, burglar alarms, police radar devices, still image cameras, video cameras, microphones, and chemical sensors, bar-code readers, document scanners, fingerprint readers, iris-scanners, vehicle counters, and optical sensors for race finish lines.

78. The GSU of claim 64, wherein said encrypted input data element is an encrypted image data set to be displayed by said client computing device and said function triggering data specifies the TS triggering coordinates at which said central processor is to (i) decrypt said encrypted input image into a decrypted image data set, and (ii) transmit said decrypted image data set through said host computer interface to said host computing device for display, and

upon said GPS receiver producing a TS-stamp data element representative of said TS triggering coordinates, said central processor automatically (i) decrypts said encrypted image data set into said decrypted image data set, and (ii) transmits said decrypted image data set through said host computer interface to said host computing device for display.

79. The GSU of claim 78, wherein said host computer interface further receives at a data sampling instant, an input data element from said host computing device, in response to the performance of said predetermined function upon said decrypted input data element, and,

wherein said central processor (i) connects the input data element received at said host computer interface with the TS-stamp data element

generated at said data sampling instant so as to produce a TS-stamped input data element, (ii) stores said TS-stamped input data element in memory, and (iii) transmits said TS-stamped input data element through said host computer interface to said GPS-enabled information receiver through said host computing device.

80. The GSU of claim 78, wherein said input data element is representative of a response to the display of said decrypted image data set.

81. The GSU of claim 78, wherein said memory is disposed within said GSU.

82. The GSU of claim 78, wherein said memory is disposed within said host computing device.

83. The GSU of claim 78, wherein said central processor further performs encryption functions on each said input data element contained within said TS-stamped input data element.

84. The GSU of claim 78, wherein said central processor further performs encryption functions on each said TS-stamped input data element.

85. The GSU of claim 78, wherein said central processor further calculates a digital signature for each said TS-stamped input data element and connects said digital signature to said TS-stamped input data element to produce a digitally-signed TS-stamped input data element which enables the verification of authenticity of the data contained in said TS-stamped input data element, at said GPS-enabled information receiver.

86. The GSU of claim 85, wherein said central processor further performs encryption functions on said digitally-signed TS-stamped input data element.

87. The GSU of claim 78, wherein said host computer interface comprises hardware and communication protocols to enable communication between said central processor and said host computing device.

88. The GSU of claim 78, wherein said host computer interface conforms to standard interface specifications selected from the group consisting of bus-based connections such as ISA, SCSI, and PCI; port-based connections such as USB,

RS232, and PCMCIA; and wireless communication methods such as infrared and radio frequency links.

89. The GSU of claim 78, wherein said host computing device further comprises a network communications interface to an information network.

90. The GSU of claim 89, wherein the network communications interface is realized a wireless communication method.

91. The GSU of claim 78, wherein said GSU is realized in the form of an integrated circuit (IC) chip.

92. The GSU of claim 78, wherein said GSU and said host computing device are realized in the form of an integrated circuit chip.

93. The GSU of claim 64, which further comprises a high-frequency GPS disciplined clock, interfaced with said central processor, for providing much higher resolution time-stamps (TS).

94. The GSU of claim 64, which further comprises a stand-alone encryption and decryption module, interfaced with said central processor, for providing enhanced speed and security.

95. The GSU of claim 64, wherein said client machine is used in a time-constrained competition against other client machines as in the case of a competitive situation selected from the group consisting of a contest against another machine, a contest against oneself under the constraint of a clock as the case of testing, and a contest against changing supply and demand conditions in a market as in the case of real-time securities, commodities, or currency trading, and other forms of real-time and non-real-time auction processes.

96. An Internet-based system for enabling a competition among a plurality of participants over the Internet, comprising:

a primary server having an embedded GPS (global positioning system) receiver;

one or more web servers for providing information about the competition;

a login server;

a competitor database;

an invitation to respond/response database;

one or more competition-promoting servers having an embedded GPS receivers; and

one or more client machines having an embedded Global Synchronization Units (GSU),

wherein all such components are interconnected with a globally-extensive network (e.g. the Internet) to enable the competition among said plurality of participants.

97. An Internet-based contest-promoting system having system components comprising :

a primary server having an embedded GPS (global positioning system) receiver;

a login server;

a contestant database;

an query/answer database;

one or more game servers, each said game server having an embedded GPS receiver and an associated antenna; and

one or more client machines, each said client machine having an embedded Global Synchronization Units (GSU);

wherein said system components are interconnected to the infrastructure of the Internet so as to enable said competition

98. The system of claim 97, which further comprises a virtual network connections between said primary server and an associated set of said game servers, as well as between each said game server and an associated set of said client machines.

99. The system of claim 97 which further comprises a plurality of mirrored web servers, each connected to said contestant database and each serving a set of said client machines, and each said client machine being equipped with a web browser.

100. The system of claim 97, wherein each said client machine is equipped with a GSU and connected through the Internet to a server equipped with a GPS clock unit.

101. The system of claim 97, wherein said GSU comprises a GPS antenna, GPS receiver, central processor, host computer interface, GPS disciplined high-frequency clock, encryption and decryption module, and non-volatile memory.

102. The system of claim 97, wherein each said client machine comprises a global synchronization unit (GSU) and various hardware and software layers, including client software such as a contest client application, contest plug-in, and contest hooks and drivers.

103. The system of claim 97, wherein each said client machine is equipped with a GSU and connected through the Internet to a server equipped with a GPS clock unit, where input and output devices are connected to said client machine through said GSU.

104. The system of claim 97, wherein said global synchronization unit (GSU) comprises a GPS antenna, GPS receiver, central processor, host computer interface, GPS disciplined high-frequency clock, encryption and decryption module, non-volatile memory, input device monitor and passthrough module, and an output passthrough and signal generation module.

105. The system of claim 97, wherein said game server comprises various hardware and software layers including a game server daemon and GPS receiver.

106. The system of claim 99, wherein each said web server comprises web server software providing support for HTML, Java, and other standard protocols and web technologies.

107. The system of claim 97, wherein said primary server comprises a primary server daemon, a contest management interface, a high precision clock or timer, high performance network interface, and a GPS receiver.

108. The system of claim 97, wherein said login server comprises a login server daemon and a high performance network interface.

109. The system of claim 97, wherein the flow of data and messages between a web server and said client machine includes web site content transmitted from said web server to the client machine, encrypted registration information posted to said web server from said client machine, preliminary contestant username and password sent to said client machine, and contest software downloaded from said web server to said client machine.

110. The system of claim 97, wherein the flow of data and messages between said primary server and said login server employed includes a list of game servers sent from said primary server to said login server.

111. The system of claim 97, wherein the flow of data and messages between one said game server and said login server includes a request for game server status by said login server, and the request includes the login server's public key for encryption, and wherein the data flow also includes an encrypted reply by the game server to said login server containing status and loading information about the game server, as well as the game server's public key for encryption use by the login server and client machine, and wherein the data flow also includes an encrypted contestant login request from said login server to the game server and a corresponding encrypted reply from the game server to said login server containing a game server access code.

112. The system of claim 97, wherein the flow of data and messages between said login server and a client machine, includes an encrypted contestant login request from the client machine to said login server, a message containing an encrypted contestant ID sent from the login server to the client machine, and an encrypted message from said login server to the client machine containing a game server address and associated game server access code.

113. The system of claim 97, wherein the flow of data and messages between one said game server and one said client machine includes a message from the client machine to the game server containing a contestant ID, a game server access code, and a client machine public key, an additional message from the game server to the client machine containing the game server public key, an additional message from the game server to the client machine containing and encrypted query and start-time, a further message from the game server to the client machine containing an encrypted query decryption key, a further message from the client machine to the game server containing a response notification hash, a further message from the client machine to the game server containing the encrypted response data and security verification hash, a further message from the game server to the client machine containing the security log request, a further message from the client machine to the game server containing the encrypted security log, a final message from the game server to the client machine containing the contest results.

114. The system of claim 97, wherein the flow of data and messages between the primary server and a game server, includes a message from the game server to the primary server containing the game server public key, an additional message from the primary server to the game server containing the primary server public key, a further encrypted message from the primary server to the game server containing the encrypted query, encrypted start-time, and encrypted answer, a further message from the game server to the primary server containing the encrypted preliminary results for the contest, a further message from the primary server to the game server containing an encrypted security analysis request, a further message from the game server to the primary server contains the encrypted security analysis results, a final message from the primary server to the game server containing the encrypted contest results.

115. The system of claim 97, wherein the flow of data and messages between the primary server and a web (http) server, includes game announcements delivered via ftp from said primary server to said web server, and additional data delivered via ftp from said primary server to said web server includes contest results and contestant standings.

116. An Internet-based financial trading-based system comprising:

a primary server equipped with a global positioning system (GPS) receiver and associated antenna;

one or more web servers;

a login server;

a trader database;

a real-time market state server;

one or more real-time price-quotation and trading (RTPQ&T) servers; and

a set of client machines,

wherein each said client machine is provided with trading client software, and wherein said login server is also connected to said trader database.

117. An Internet-based auction-supporting system having system components comprising:

a primary server with an embedded GPS receiver and associated antenna;

one or more web servers;

a login server;

a bidder database;

an auction database;

one or more auction servers with embedded GPS receivers; and

one or more client machines with an embedded Global Synchronization Units (GSU),

wherein all system components are interconnected to the infrastructure of the Internet.

118. The Internet-based auction-supporting system of claim 117, which further comprises virtual network connections between said primary server and a set of said auction servers, as well as between each said auction server and an associated set of said client machines.

119. The Internet-based auction-supporting system of claim 117, which further comprises a plurality of mirrored web servers, each being connected to said bidder database and each serving a set of said client machines, and each said client machine being equipped with a web browser.

120. The Internet-based auction-supporting system of claim 117, wherein each said client machine is provided with a bidding client, and said login server is connected to said bidder database.

121. The Internet-based auction-supporting system of claim 117, wherein each said client machine comprises a global synchronization unit and various hardware and software layers, including client software such as an auction client application, auction plug-in, and auction hooks and drivers.

122. The Internet-based auction-supporting system of claim 117, wherein said auction server comprises various hardware and software layers including an auction server daemon and GPS receiver.

123. The Internet-based auction-supporting system of claim 117, wherein said web server includes web server software providing support for HTML, Java, and other standard protocols and web technologies.

124. The Internet-based auction-supporting system of claim 117, wherein said primary server includes the primary server daemon, an auction management interface, a high precision clock or timer, high performance network interface, and a GPS receiver.

125. The Internet-based auction-supporting system of claim 117, wherein said login server includes the login server daemon and a high performance network interface.

126. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between a web server and one said client machine includes web site content transmitted from the web server to the client machine, encrypted registration information posted to the web server from the client machine, preliminary bidder username and password sent to the client machine, and auction software downloaded from the web server to the client machine.

127. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between the primary server and the login server includes a list of auction servers sent from the primary server to the login server.

128. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between an auction server and the login server includes a request for auction server status by the login server, and the request includes the login server's public key for encryption, and wherein the data flow also includes an encrypted reply by the auction server to the login server containing status and loading information about the auction server, as well as the auction server's public key for encryption use by the login server and client machine, wherein the data flow also includes an encrypted bidder login request from the login server to the auction server and a corresponding encrypted reply from the auction server to the login server containing a auction server access code.

129. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between the login server and a client machine, includes an encrypted bidder login request from the client machine to the login server, a message containing an encrypted bidder identification sent from the login server to the client machine, and an encrypted message from the login server to the client machine containing an auction server address and associated auction server access code.

130. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between an auction server and a client machine, includes a message from the client machine to the auction server containing a

bidder ID, an auction server access code, and a client machine public key, an additional message from the auction server to the client machine containing the auction server public key, an additional message from the auction server to the client machine containing and encrypted minimum and start-time, a further message from the auction server to the client machine containing an encrypted bid decryption key, a further message from the client machine to the auction server containing a response notification hash, a further message from the client machine to the auction server containing the encrypted response data and security verification hash, a further message from the auction server to the client machine containing the security log request, a further message from the client machine to the auction server containing the encrypted security log, a final message from the auction server to the client machine containing the auction results.

131. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between the primary server and said auction server, includes a message from the auction server to the primary server containing the auction server public key, an additional message from the primary server to the auction server containing the primary server public key, a further encrypted message from the primary server to the auction server containing the encrypted auction, encrypted start-time, and encrypted answer, a further message from the auction server to the primary server containing the encrypted preliminary results for the contest, a further message from the primary server to the auction server containing an encrypted security analysis request, a further message from the game server to the primary server contains the encrypted security analysis results, a final message from the primary server to the auction server containing the encrypted auction results.

132. The Internet-based auction-supporting system of claim 117, wherein the flow of data and messages between the primary server and a web server includes auction announcements delivered via ftp from the primary server to the web (http) server, and additional data delivered via ftp from the primary server to the web server includes auction results and bidder standings.

133. An Internet-based contest-promoting subsystem comprising:

one or more remote administration consoles;

a contest database; and

a remote administration server for remotely creating and administering contests over the Internet.

134. A system for remote administration of contests over the Internet, comprising:

a virtual network of connections between a primary server and a remote administration server, between the remote administration server and a contest database, a contestant database, and a query answer database, as well as between said remote administration server and one or more remote administration consoles.

135. The system of claim 134, wherein a remote administration console employed in said system comprises administration software being comprised of a remote administration client application and a remote administration plug-in.

136. The system of claim 134, wherein said remote administration server comprises various hardware and software layers, including the remote administration web server and the remote administration daemon.

137. A subsystem for providing a competition-promoting systems with a television-based spectator interface, comprising:

a web server;

a video-enabled client machine;

a web-to-video processor;

tape video content playback unit;

live video source (e.g. camera);

a real-time video compositor;

broadcasting equipment; and

television viewers.

138. A display layout for displaying contest live video, contestant images, and live contest queries, results, scores and statistics on a television-based spectator interface.

139. A television-based client machine comprising:

a set-top client machine connected to the user's television set using a standard NTSC or PAL cable; and

a remote-control input device for controlling the client machine.

140. The television-based client machine of claim 139, wherein said set-top client machine comprises

a GPS receiver and associated antenna,

clock and timer hardware;

a television tuner with decoding capabilities;

a modem;

audio/video output;

embedded device drivers;

an embedded operating system with Java capability running on a microprocessor; and a

firmware contest client.

141. An Internet-based competition-promoting system for fairly and securely enabling one or more time-constrained competitions among a plurality of competitors simultaneously presented with the same set of data, comprising:

a first subsystem for transmitting an Invitation-to-Respond, or ITR, to each of the competitors participating in the competition promoted by said system in a regulated manner; and

a second subsystem for responding to each ITR presented to said competitors, by submitting an appropriate response or undertaking a particular action;

wherein each competitor's response is the timed to ensure fairness in the competitive activity, and thus precisely measured, securely recorded and analyzed.

142. The Internet-based competition-promoting system of claim 141, wherein said same set of data (i.e. in a globally time-synchronized manner) is data selected from the group consisting a question to be answered, and a problem, puzzle or riddle to be solved.

143. The Internet-based competition-promoting system of claim 141, wherein said competitors are selected from the group consisting of human beings, programmed computers, and sophisticated androidal machines.

144. The competition-promoting system and method of claim 141, wherein said time-constrained competition is an activity selected from the group consisting of multi-player timed problem-solving games, puzzles, or contests; on-line real-time auctions, on-line real-time trading of securities (e.g. stocks and bonds), commodities, and foreign currencies; on-line real-time auctions; on-line educational testing; on-line career testing; on-line aptitude testing; on-line intelligence quotient (IQ) testing; and other real-time activities wherein

simultaneous presentation of information to a plurality of competitive entities or accurate presentation of IRQs to and collection of responses thereto from one or more human subjects, is critical to the competitive or otherwise time-constrained activity at hand, in order to ensure fundamental principles of fairness and fair play expected by participants, spectators, and sponsors alike.

145. An Internet-based competition-promoting system having system components comprising:

a primary server for providing as a source of Invitations-to-Respond and other competition related data; providing a master clock for the system; and performing functions or operations involving data received from multiple client machines connected to the system;

a login server for accepting login requests from each competitor's client machine and assigning an appropriate competition-promoting server to that client machine, providing a single address for each client machine to use to contact the assigned competition-promoting server when initializing a session in the competition, and intelligently distributing the processing and communications load among the competition-promoting servers;

a competitor database for recording information about each competitor for the proper operation of the competition;

an Invitation-To-Respond/Response (ITR/Response) database for storing or generating Invitations-To-Respond (ITRs) appropriate to the particular competition being promoted, and transmitting those ITR's to said client machines, through the other servers in the system;

one or more competition-promoting servers; and

a plurality of client machine for use by a plurality of competitors, wherein each said competitor interacts with said competition-promoting system through one said client machine, and

wherein said system components are interconnected through the infrastructure of the Internet.

146. The Internet-based competition-promoting system of claim 145, said competitor database records items of information about each said competitor, selected from the group consisting of his or her identity, preferences, contact information, and any other data deemed necessary for the proper operation of the competition.

147. The Internet-based competition-promoting system of claim 145, wherein said ITR/Response database contain canonical responses for comparison with the

actual responses generated by the competitors, as well as other information necessary for the conducting of the competition.

148. The Internet-based competition-promoting system of claim 145, wherein each said client machine includes a global synchronization unit (GSU), whereas each said competition-promoting server includes a GPS receiver.

149. The Internet-based competition-promoting system of claim 145, wherein said global positioning unit (GSU) employed by the competition-enabling system comprises:

a plurality of GPS receivers operating in conjunction with an array of GPS satellites occupying a geodesic orbit.

150. The Internet-based competition-promoting system of claim 145, wherein said primary server communicates indirectly with said client machines through a number of competition-promoting servers, wherein said competition-promoting servers relay Invitations-To-Respond and other data to the client machines, and receive responses thereto from those client machines.

151. The Internet-based competition-promoting system of claim 145, wherein said competition-promoting servers perform preliminary processing and sorting of the client machine responses and these pre-processed results are then passed back to said primary server.

152. The Internet-based competition-promoting system of claim 145, wherein each said competitor uses one said client machine to receive and view the Invitations-To-Respond (ITR), as well as to enter and transmit the responses thereto.

153. The Internet-based competition-promoting system of claim 145, wherein said client machine comprises a personal computer, augmented by the addition of several software and hardware components, including a global synchronization unit (GSU) 175 installed in the client machine to provide precisely time-stamp client-responses, referred to as client-events, traceable to internationally standardized reference clocks.

154. The Internet-based competition-promoting system of claim 145, wherein said GSU within each client machine performs decryption operations, generates digitally-signed time and space stamps of various internal and external events at

the client machine, and supports timed decryption and presentation of data to the competitor.

155. The Internet-based competition-promoting system of claim 145, wherein each computer or device in the system will establish a connection or connections to one or more of the other computers through the communications network

156. The Internet-based competition-promoting system of claim 145, wherein said connections are virtual connections established through said communications network such as the Internet.

157. The Internet-based competition-promoting system of claim 145, wherein said communications network comprises a packet-switched data communications network running the popular Transmission Control Protocol/Internet Protocol (TCP/IP).

158. The Internet-based competition-promoting system of claim 145, wherein each said competition server connected to said communications network has a statically assigned IP address, whereas each said client machine connected thereto has either a statically or dynamically assigned IP address.

159. An Internet-based contest-promoting system for enabling a plurality of contestants to participate in a multi-player internetworked time-constrained contest that is regulated in a secure and fundamentally fair manner, comprising:

an information server for supporting a contest process over the Internet and producing invitations to respond (ITR) for response to said contestant in a time-constrained manner;

a plurality of client machines, each said client machine for use by one said contestant to interface with the contest process, receive an ITR (i.e. images, text, video, play audio streams) displayed in a globally time-synchronized manner, receive a response to the ITR from the contestant in a time-constrained manner, time-stamping said response at the client machine, and transmitting the response and corresponding time-stamp to said information server;

said information server including means for evaluating and ranking said contestants are according to their responses and corresponding time-stamps;

means for registering contestants participating in the contest;

means for controlling and measuring certain time-based elements of the contest (e.g. the precise instant at which an ITR is presented to the contestants) on all or some subset of the client machines,

wherein said time-based elements shall include the "start- time" which is the same for each contestant,

wherein the contest-promoting system includes means for precisely determining the length of time between the start-time and the instant each contestant submits its response which provides the finish-time of the particular contestant,

wherein the length of time, measured between said start-time and said finish-time, provides the response-time of the particular contestant or competitor.

160. The Internet-based contest-promoting system of claim 159, wherein said ITRs (e.g. queries) are simultaneously presented to each and every client machine registered to compete in the contest.

161. The Internet-based contest-promoting system of claim 159, wherein each client machine incorporates a global positioning system (GPS) receiver, and a local clock contained in an embedded or peripheral device to provide a precise timing reference (e.g. accurate to within 1 microsecond of international atomic clock standard time).

162. The Internet-based contest-promoting system of claim 159, wherein said GSU are programmed to decode and present the ITR in a secure manner at the precise moment desired.

163. The Internet-based contest-promoting system of claim 159, wherein each client machine includes a local clock that is characterized, or analyzed to determine the functional relationship between the local clock time and the global time as determined by a single master clock for the entire contest system, wherein the global time may be determined from the local clock reading.

164. The Internet-based contest-promoting system of claim 159, wherein the display update cycle on each client machine is skewed so that a display update completes exactly at the desired "start time" which is determined to be the same for each every contestant, regardless of their location on the planet.

165. The Internet-based contest-promoting system of claim 159, wherein said characterization of the local clock is performed using an accurate clock connected to the client machine, or using security enhanced versions of the methods and algorithms used in the network time protocol (NTP).

166. The Internet-based contest-promoting system of claim 159, wherein said contest-promoting system further comprises security measures for detecting (and thereby discouraging) cheating by dishonest contestants.

167. The Internet-based contest-promoting system of claim 166, wherein said security measures comprise the use of encryption of the majority of messages between the various computers in the system, and by monitoring and logging the contest-related activities of participating client machines.

168. An Internet-based contest-promoting system for supporting a contest among a large number of contestants, comprising:

a subsystem for handling transmission of the queries and responses from all of the client machines employed in the contest, said subsystem including a hierarchy of servers comprising a primary server, plurality of game servers and client machines,

wherein said primary server acts as the root node of a tree-type interconnection of computers,

wherein the "leaves" of the tree structure are formed by the client machines connected to the system, and

a layer of game servers act as intermediaries (or "branch structures") between said primary server and the client machines.

169. The Internet-based contest-promoting system of claim 168 wherein, each game server, client machine, and primary server is equipped with a GPS receiver used to synchronize the local clock and the display of each client machine participating in the contest-promoting system.

170. The Internet-based contest-promoting system of claim 168 wherein, management of time synchronized messaging with each client machine can be carried out by the game server associated with that client machine, rather than by the primary server.

171. A method of registering a contestant with an Internet-based contest-supporting system, comprising the steps of:

(a) registering a client machine with said Internet-based contest supporting system by filling out a web-based form containing personal and client machine information and submitting said completed form to a web server;

(b testing and qualifying said client machine using either browser plug-ins or stand alone test programs downloaded from said web server; and

(c) downloading contest client software to said client machine.

172. A method of registering a contestant with a contest-supporting system, comprising the steps:

(a) collecting and recording information about each contestant desiring to participate in a scheduled contest, said information including, for example, the name, address, telephone number(s), E-mail address, and any other information required or desired of each contestant by the contest organizer and/or sponsor(s);

(b) choosing or assigning an identification number (or "handle") and a password, in order to protect their access to the contest process;

(c) at registration time, performing a number of tests on the contestant's system, said tests can be used to qualify the client machine to be used by the contestant, by determining whether it meets certain requirements necessary to successfully participate in the contest.

(d) recording data produced as a result of these tests, either on the client machine or on one of the servers;

(e) using said data, in conjunction with other information collected during and/or after the contest, to help determine whether the contestant participated fairly in the competition;

(f) downloading before the contest, any programs, installable components, and plugins, as well as any data required by them; and

(g) using said programs, components, and plugins, along with a browser or other programs already present on the contestants system, to present advertising and other information and content to the contestant, as well as to perform all operations of the contest on the client machine.

173. A system for distributing and presenting Web documents (with or without Java or Active-X applets) and associated web content to the contestants, comprising:

a set of Web-enabled client machines equipped with web browsers; and

a contestant database for storing registration and other information;

a master web server for storing and providing the web site content to a set of client machines, utilizing HTTP, FTP, and other standard Internet protocols;

a plurality of mirrored web servers, wherein each web server is connected to said contestant database and each serves a set of Web-enabled client machines equipped with web browsers;

said master web server transmits copies of the entire contest web site to the mirror web servers, which then are each able to serve a large number of client machines;

wherein each of the web servers has access to said contestant database;

said web servers also distribute the contest client software (340) using the HTTP or FTP protocols.

174. The system of claim 173, wherein said Web document comprises an HTML (or XML) encoded document

175. A method of handling communication in a multi-player contest using multiple game servers to handle communication with all client machines in a contest-promoting system, said method comprising:

(a) using a client machine to initially connect to the contest-promoting system through a login server located at a known Internet address;

(b) using login server to choose which game server should be utilized by this contestant's client machine, said choice being based on a variety of information, including the location of the client machine, the characteristics of the connection to the client machine, and the number and characteristics of the connections already assigned, or anticipated to be assigned, to the game servers in the system;

(c) using load balancing algorithms to distribute the connections to the game servers, thereby minimizing the possibility of overwhelming any one server, and insuring consistent connections for all the game clients.

176. The method of claim 175, wherein all said client machines receive their game server assignments from a single login server.

177. The method of claim 175, wherein each client machine is running the contest client software for interfacing said client machine with said game server by logging in through said login server.

178. The method of claim 175, wherein said the login server accesses the contestant database to check passwords and the status of the contestant.

179. A method of enabling a contestant to compete against many other contestants, in a secure and fundamentally fair time-constrained contest, over the Internet, wherein each contestant is provided with a common "start-time" regardless of the location of his or her client machine on the infrastructure of

the Internet, for the type of interconnection provided thereto, said comprising the steps of:

(a) registering each user as a contestant using a web browser;

(b) creating a globally-synchronized and secure networked client machine through which the contestant may participate in a timed-constrained question and answer type contest, while competing against large numbers of other contestants for potentially high stakes.

(c) using the contest client software on the client machine to log on to the game server, and the establish a communication channel therewith;

(d) transmitting the query and start-time from the primary server to the client machine;

(e) characterizing the client machine's local clock with the master clock on the primary server, and synchronizing f the client machine display update cycle with the desired start-time for the contest;

(f) presenting the query to the contestant precisely at the start-time, as determined by a local clock that is characterized with respect to a global master clock located on the primary server;

(g) accepting the contestants response, attaching a time-stamp to that response, and transmitting the response and time-stamp to the servers;

(h) judging the responses from all the contestants and determining the winner.

180. The method of claim 179, wherein said method further comprises (i) determining each contestant's standing or rank for the contest.

181. The method of claim 179, wherein step (a) comprises browsing a contest WWW site ("the contest web site") containing information about the contest, including descriptions of the contest client software, contestant qualifications, contest regulations, instructions on how to play, information about different varieties of the contest, lists of prizes and awards offered, advertising, lists of contest sponsors, lists of previous winners, and the standings or ranks of other contestants.

182. The method of claim 179, wherein step (a) comprises a flow of information between the user's client machine and the web server containing HTML (and/or XML) encoded documents comprising the contest web site.

183. The method of claim 179, wherein step (a) comprises the user registering to become a contestant involving the user filling out an on-line registration form,

using either standard HTML (or XML) forms, or forms generated by Java or Active-X applets, or by a CGI script in a manner well known in the art.

184. The method of claim 179, wherein step (a) comprises the user performing some test either of their own abilities and/or of the capabilities of their computing system, said tests being administered through forms along with the registration process, or could involve the user downloading and running customized plug-in modules or stand-alone applications on his or computing system.

185. The method of claim 179, wherein step (a) further comprises:

said web server creating a record in the contestant database for this user upon completing receipt of the registration information therefrom;

storing the registration information in this record;

establishing the user as a contestant permitted to participate in one or more on-line multi-player contests to be promoted (i.e. enabled) the system of the present invention;

assigning a contestant ID to the new contestant, said ID code uniquely identifying the contestant for all time, unlike a username, password, e-mail address or other information that may be changed in the future by this player/contestant;

recording the contestant ID in the contestant database, and using the same internally by the contest software of the system.

assigning the contestant a username and a temporary password for use when playing the contest, said username being assigned by the system, or being chosen by the user as a part of the registration procedure, said password being generated randomly, and said username and password being stored in the contestant database;

sending an e-mail message containing the username and temporary password to the contestant;

logging said contestant onto a secure, members-only area of the contest web-site using his or her username and temporary password, said area allowing the contestant to view and update his or her personal information (e.g. username, password, e-mail address, residence address and telephone numbers, and so on);

downloading the contest software from the web server to his or her client machine, i.e. from the members-only area of the contest web site, said contest software being download using HTTP, FTP, or other file transfer protocol;

installing the client contest software on client machine, said installation installing contest client application, as well as one or more customized device drivers required by the contestant's client machine, said device drivers being used to communicate directly with the local clock and any timing hardware (GPS, etc) used in the client machine,

thereby enabled the client machine for participation in a contained competition

186. A method of logging a contestant onto a game server using a client machine connected to a contest-promoting system having a log-in server, and a plurality of game servers, said method comprising the steps of:

(a) providing all servers and client machines in the system with the address of said login server as well as with the login server's encryption "public key", which is used to send secure message to said login server;

(b) transmitting a list of all the participating game servers from said primary server to said login server, said message being encrypted using said login server's public key;

(c) said login server decrypting and storing said message using said login-server private key;

(d) sending a status request message from said login server to each of said game servers;

(e) each said game server sending a reply in response to the status request message, containing information about the status of the game server, including current loading, indications of maximum server capacity, geographical area of coverage, and other information,

wherein said reply contains the game server's public encryption key, and the entire reply is encrypted using the login server's public key;

(f) said contestant logging on to the system using the contest client application when the contestant decides to installation of the client software, participate in a particular contest;

said contest client machine requesting a username and password from the contestant for the convenience of the contestant;

(optionally, storing said username and password locally on said client machine to avoid the contestant having to re-enter the username and/or password every time he or she plays a game or participates in a contest)

(g) said contest client software transmitting the username and password to the login server;

encrypting the username, password, and the client machine's public key using said login server's public key, and sending the resulting login request from the client machine to said login server;

(h) login server decrypting the login request, obtaining the username and password, said username and password being obtained by performing a lookup operation in the contestant database, thereby obtaining a contestant ID;

(i) transmitting said contestant ID to the client machine and said client machine storing said ID for later use;

(j) said login server selects an appropriate game server for this contestant, based on loading, geographical location, and other factors;

(k) upon selecting a game server, the login server sending a login request containing the contestant ID and the client machine address to the selected game server, said message being encrypted using the game server's public key;

(l) If the login request is granted, then the game server creates a message containing a game server access code, encrypted using the login server's public key;

(m) sending said message (containing the game server access code) from the game server to the login server; and

(n) creating the game server access code (key) using the contestant ID and the client machine address, said code only allowing the specified contestant to log in using that code.

187. The method of claim 187, wherein further the login server decrypts the message, and then creates a new message containing the game server's address and the game server access code, and then encrypts the new message using the client machine's public key, and sent from the login server to the client machine.

188. The method of claim 187, wherein further the client machine decrypts the message containing the game server address and the game server access code using its private decryption key.

189. The method of claim 188, wherein further the client machine then creates a message containing the contestant ID, the game server access code, and a client machine public encryption key, and then the message is sent from the client machine to the game server specified by the game server address received from the login server.

190. The method of claim 189, wherein further the game server responds with message containing the game server public key, and then the client machine has

successfully logged on to the game server chosen for the client machine by the login server.

191. A method of downloading an encrypted query and start-time to the client machine comprising the steps of:

(a) human operators entering the questions and associated answers relating to a particular contest into the query/answer database;

(b) at some point before the contest begins, the game server sends to the primary server, a message containing its public encryption key.

(c) primary server sends to the game server, a message containing its public encryption key;

(d) when a particular contest is created, accessing the system through the contest management interface, and selecting queries from the database to be used in the contest;

(e) for each query, assigning a desired start-time;

(f) for each query and start-time, the primary server generates a unique set of query encryption and decryption keys;

(g) using the query encryption key, the primary server encrypts the query;

(h) the primary server creates a message containing the encrypted query, the query decryption key, and the desired start-time;

(i) the entire message is encrypted using the game server's public encryption key;

(j) entire message is sent from the primary server to the game server;

(k) upon receiving the message from the primary server, the game server decrypts the message and creates a new message, and the new message is encrypted by the game server using the client machine's public key;

(l) the resulting encrypted message is sent to the client machine;

(m) the client machine decrypts the message, and stores the encrypted query contained within, along with the start-time on the client machine;

(n) the client machine creates and begins appending data to a security verification log file, and the resulting encrypted file will contain a variety of information about the timing of the query/response process;

(o) the security verification log recording the arrival-time (in local time) of the encrypted query from the game server.

192. A method of characterizing the local clock on a client machine and synchronizing the display update cycle of the client machine for a system that utilizes a GSU, said method comprising the steps of:

adjusting the display refresh cycle such that a cycle completes precisely at the desired start-time;

measuring the video refresh rate of the video display adapter in the client machine, wherein said video display adapter has a set of registers used to control and monitor the scanning and refresh periods and rates;

query the display adapter to determine whether it is currently in a vertical retrace period or not, over a period of time;

recording the local clock time each time the display enters vertical retrace, the period and phase of the display update cycle is determined with respect to local clock time;

by reading the display adapter registers, determining the difference between the time the last line of the displayed image is drawn and the beginning of the next vertical retrace;

using this calculated period and phase, extrapolating the display times forward in time to find the display time closest to the desired start-time;

calculating the error (E_d) between the display time (t_d) and the desired local clock start time (t_{sl});

throughout this process, appending the times associated with each vertical retrace to the security verification log;

minimizing the error term E_d is by shifting the phase of the display update cycle; and

adjusting the phase of the display update cycle is by increasing or decreasing the display update period over a number of update cycles in order to minimize E_d and completely display the query at the desired start-time.

193. A method of presenting an encrypted query to a GSU-enabled client machine at a contest start-time associated with a contest-promoting system, wherein the encrypted query and start-time have been stored on the GSU-enabled client machine, and the display time has been aligned with the contest start-time, said method comprising the steps of:

(a) the GSU-enabled client machine uploads the encrypted query and start time to the GSU within the GSU-enabled client machine, said GSU-enabled client machine having video memory and a display;

(b) a short time prior to the desired start-time, the GSU decrypts the query, and then said query is downloaded to the GSU-enabled client machine;

(c) the query is then rendered into a off-screen image and stored in an off-screen memory area in preparation for presentation on the display;

(d) during the vertical retrace period that is one cycle before the display time, the off-screen image is flipped to the display;

(e) with the query image now residing in the currently displayed video memory, the GSU-enabled client machine display draws the query onto the screen, reaching the bottom of the display at the start-time for the contest; and

(f) the GSU-enabled client machine records the local time at the moment the vertical retrace begins, which should be simultaneous with the desired start-time.

194. The method of claim 193, which further comprises:

(g) the local time is also stored in the security verification log;

(h) after the image is displayed, the client machine continues to monitor the clocks and timing systems on the GSU-enabled client machine (e.g. system timer, real time clock, CPU cycle counter, vertical retrace signal, etc); and

(i) information about the clocks is stored in the security verification log.

195. A method for presenting an encrypted query to a GSU-enabled client machine at a contest start-time associated with a contest-promoting system, wherein the encrypted query and the contest start-time have been stored on the GSU-enabled client machine, said method comprising the steps of:

(a) the client machine uploads the encrypted query and start time to the GSU of said GSU-enabled client machine, said GSU-enabled client machine having a display and the GSU having display memory;

(b) the GSU decrypts the encrypted query immediately prior to the contest start-time;

(c) the decrypted query is then rendered by the GSU into said display memory; and

(d) the GSU overrides the display, using its own synchronized refresh rate, and presents the query precisely at the contest start-time.

196. A method of presenting an encrypted query to a client machine at a contest start-time associated with a contest-promoting system having a contest server, wherein the encrypted query has been stored on the client machine, the start-time is known in terms of the local clock, and the display time has been aligned with the desired start-time, said method comprising the steps of:

(a) contest server transmitting the query decryption key to the client machine, said client machine having video memory and a display;

(b) the client machine decrypts the query upon receipt of the query decryption key, and the local clock time of the receipt of the query decryption key is recorded in a security verification log;

(c) the query is then rendered into an off-screen image and stored in an off-screen memory area, in preparation for presentation on the display;

(d) during the vertical retrace period that is one cycle before the display time, the off-screen image is flipped to the display; and

(e) with the query image now residing in the currently displayed video memory, the client machine display draws the query onto the screen, reaching the bottom of the display at the contest start-time.

197. A method of submitting a time-stamped contestant response to a query presented to a GSU-enabled client machine by a contest server associated with a contest-promoting system, said method comprising the steps of:

(a) entering the response into the GSU-enabled client machine, said GSU-enabled machine having a GSU;

(b) sending the response to the GSU, which generates digitally signed data package containing the time and space stamp for the response;

(c) within the GSU, appending the time and space stamp to the security verification log.

(d) sending the time and space-stamp from the client machine to the contest server; and

(e) the contest server requesting the actual (i.e. full) response from the client machine by sending a response request message.

198. The method of claim 197, which further comprises:

(f) if requested, the client machine encrypts the response, the response time-stamp, and a hash-value of the security verification log in order to create a message; and

(g) sending the message to the contest server and closing and write-protecting the security verification log.

199. A method of submitting a time-stamped contestant response to a query presented to a GSU-enabled client machine by a contest server associated with a contest-promoting system, wherein the GSU-enabled client machine has a GSU with a GSU passthrough connection and an input device connected directly thereto, said method comprising the steps of:

(a) contestant uses the input device to enters the response into the GSU-enabled client machine through said GSU passthrough connection;

(b) the GSU automatically generates a digitally signed time and space stamp for the response;

(c) the time and space-stamp is appended to the security verification log;

(d) sending the time and space stamp from the client machine to the game server; and

(e) the contest server requests the actual response from the GSU-enabled client machine by sending a response request message.

200. The method of claim 199, which further comprises:

(f) if requested, the GSU-enabled client machine encrypts the response, the response time-stamp, and a hash-value of the security verification log to create a message; and

(g) the GSU-enabled client machine sends the message to the contest server and closing and write protecting the security verification log.

201. A method of submitting a time-stamped contestant response to a query presented to a client machine by a contest server associated with a contest-promoting system, said client machine having an interrupt handler and a customized low-level device driver, method comprising the steps of:

(a) the contestant enters a response into the client machine;

(b) response submission being detected by the customized low-level device driver;

(c) the interrupt handler in the client machine recording the local time-stamp corresponding to the moment the response was submitted to said client machine;

(d) appending this local time-stamp to a security verification log;

(e) upon receipt of the response submission, after recording the time-stamp, the client machine calculating a hash or CRC (cyclic redundancy check) value using the contestant's response and the local time-stamp;

(f) appending the hash value to the security verification log;

(g) sending a message containing the hash value and the response time, from the client machine to the contest server; and

(h) the contest server requests the actual (i.e. full) response from the client machine by sending a response request message.

202. The method of claim 201, which further comprises:

(i) if requested, the client machine encrypts the response, the response time-stamp, and a hash-value of the security verification log to create a message; and

(f) message is then sent to the contest server and the security verification log is closed and write protected.

203. A method of promoting a contest over the Internet using an Internet-based contest-promoting system having a primary server, a one or more contest servers, a database and a plurality of client machines, and for fairly determining the winners of the contest, said method comprising the steps of:

(a) as responses are received by each contest server from said client machines, comparing the responses with the correct answers in the database;

(b) of those responses containing correct answers, comparing the time-stamps to rank the responses from fastest to slowest;

(c) encrypting the sorted preliminary results using the primary server's public key;

(d) sending the encrypted preliminary results (i.e. rankings), from the contest server to the primary server;

(e) the primary server decrypting the encrypted preliminary results from each contest server;

(f) merging the pre-sorted preliminary rankings from the contest server into a single sorted list of responses;

(g) from the presorted list, the primary server calculating the overall ranking of the contestants and identifies the winner or winner(s) of the contest;

(h) for each winning response, the primary server sends a security analysis request to the game server that is connected to the corresponding client machine of the contestant who submitted that response;

(i) in response, each game server sends the security log, to the corresponding client machine;

(j) the client machine transmits to the contest server, the security verification log, encrypted using the game server's public key;

(k) the contest server decrypts and verifies the integrity of the security verification log using the hash-value of the security verification log;

(l) the contest server uses the content of the security verification log to attempt to detect fraudulent activities;

(m) the response notification hash is used to make sure the response sent is consistent with the response entered at the response notification time;

(n) the contest server compiles the results from all the requested security logs for the client machines and transmits this message to the primary server;

(o) upon receiving the compiled results from all the contest servers, the primary server either accepts, rejects, or flags the winning responses for further analysis by other means;

(p) the primary server creates a revised list of winners based on these changes determined during step (o);

(q) the revised list is encrypted using the contest server's public key and the resulting message is sent back to the contest server;.

(r) each game server in turn transmits the contest results message to each of the client machines; and

(s) sending a message containing the contest results from the primary server to a web server for posting on a contest web site.

204. A global synchronization unit (GSU) comprising:

means for performing actions in response to precise time and space conditions.

205. The GSU of claim 204, wherein the trigger for a time and space stamping action is constrained by timing, location, and/or velocity conditions of the GSU.

206. The GSU of claim 204, wherein said actions comprise events selected from the group consisting of the display of an image, the start of a video or audio clip, the decryption of data, and the running of a program on a host client machine.

207. A global synchronization unit (GSU) comprising:

means for generating secure and verifiable time-space stamp records of client-machine inputs and any other events captured by devices attached or otherwise connected to the GSU.

208. The GSU of claim 207, wherein said client-machine inputs are supplied from a communication line being asserted on the GSU input, or as complex as a set of patterns of inputs on a number of different inputs.

209. The GSU of claim 207, wherein the time-space stamp record generated by the GSU includes the location, exact time (e.g. to within +/- 1 microsecond).

210. The GSU of claim 207, wherein said GSU generates security information including, but not limited to, a hash or CRC (cyclic redundancy check) value derived from the input data associated with the event.

211. The GSU of claim 210, wherein said hash value allow the data to be verified in the future to insured that it has not been altered since the time/space stamp was generated.

212. The GSU of claim 207, wherein said time-space stamp record has an associated CRC value or digital signature to insure that the time-space stamp record itself is genuine and unmodified.

213. A global synchronization unit (GSU) comprising:

means for performing actions in response to precise time and space conditions; and

means for generating secure and verifiable time and space-stamped records of client-machine inputs and any other events captured by devices attached or otherwise connected to the GSU.

214. A method of synchronizing events on plurality of client machines, comprising the steps of:

(a) equipping each said client machine with a GSU;

(b) downloading into each said GSU, data in an encrypted form;

(c) decrypting said data in said GSU to produce trigger data; and

(d) using said trigger data in said GSU to trigger an event at a precise instant of time.

215. The method of claim 214, wherein said plurality of client machines are operably connected to the infrastructure of the Internet.

216. A method of triggering an event on a client machine, comprising the steps of:

(a) equipping said client machine with a GSU;

(b) downloading into each said GSU, data in an encrypted form;

(c) decrypting said data in said GSU to produce trigger data;

(d) use said trigger data in said GSU to trigger said event at either a precise instant of time, a precise location in space or a precise velocity at which said GSU is travelling.

217. The method of claim 216, wherein step (a) comprises configuring said GSU through said client computer interface to perform a specific action when those conditions are satisfied.

218. A GSU device comprising:

circuitry for generating time and space stamps for an input data element;

circuitry for forming a data package including said time and space stamp and said input data element; and

circuitry for digitally signing said data package to produce a digitally signed data package.

219. The GSU device of claim 218, which further comprises

circuitry for authenticating that time and space stamp contained within said digitally data package, has not been modified since said time and space stamp was generated.

220. The GSU device of claim 218, wherein said input data is data selected from the group consisting of legal documents, tickets, certificates and financial instruments.

221. A system for performing an action on a client machine operably connected to the infrastructure of the Internet, said system comprising:

an information server equipped with a GPS receiver and associated antenna, and operably connected to the infrastructure to the Internet;

a GSU operably connected to said client machine;

wherein said information server sends an encrypted request to said client machine to perform an action at a predetermined event time, said encrypted request containing encrypted action data;

said encrypted request is then loaded into said GSU for decryption at said predetermined event time;

at some predetermined time before said predetermined event time, said GSU decrypts the encrypted action data and downloads the decrypted action data back onto said client machine for performance of said action,

thereby preventing access by said client machine or its operator to the action data before said predetermined event time.

222. The system of claim 221, wherein said action data comprises image data contained in said encrypted request, and the performance of said action comprises displaying said image data on a display device operably connected to said client machine.

223. A subsystem for creating and administrating contests promoted by a contest-promoting system supported over the Internet, said subsystem comprising:

a primary server operably connected to the infrastructure of the Internet;

a contest database operably connected to the infrastructure of the Internet, for containing information representative of questions and answers relating to one or more contests to be supported over the Internet;

a contest management interface software located on said primary server for use by the contest administrators to enter questions and answers into said contest database, design and specify contests, schedule contests, and monitor and control said contests.

224. The subsystem of claim 223, which further comprises a Web-enabled client machine for use by contest administrators to remotely enter questions and answers into said contest database, design and specify contests, schedule contests, and monitor and control said contests.

225. In a contest-promoting system having a primary server, a subsystem for producing and distributing a live television broadcast of a contest in progress, to television viewers viewing said live television broadcast on standard television sets throughout the world, said subsystem comprising:

a plurality of video-enabled client machines for capturing live video images and producing digital content;

Web-to-video processor for filtering, formatting and rendering (i) data generated by said primary server and distributed through said web server, and (ii) data transmitted by said video-enabled client machines, so as to produce digital content;

a video content playback unit for producing digital content in the form of prerecorded video information;

a live video source for producing digital content in the form of a live video stream;

a real-time video compositor for combining and laying out the digital content produced by one or more of said Web-to-video processor, said live video sources, and said taped video content playback sources, and producing a video signal representative of single unified view depicting the various aspects of a contest in progress; and

broadcasting equipment for broadcasting said video signal to television broadcasts.

226. The subsystem of claim 225, which further comprises a Web server for serving web-pages containing information about the content to be shown in said live television broadcast.

227. The subsystem of claim 225, wherein each said video-enabled client machine comprises a client machine having a video camera and associated video compression and transmission software.

228. The subsystem of claim 225, wherein said the real-time video compositor sends the final video signal to said broadcasting equipment, which transmits the video signal to the spectators television sets via cable, satellite, and/or radio waves.

229. A set-top television client machine for use in a contest-promoting system having a primary server for transmitting queries or Invitations to Respond (ITRs), comprising:

a television screen;

a local clock and timer hardware;

a GSU having GPS receiver for disciplining said local clock;

wherein said local clock is used to trigger the display of queries on said television screen, as well as to measure the elapsed time taken by the user when answering said queries (or submitting responses to said ITRs).

230. The set-top television client machine of claim 229, which further comprises an operating system having Java capability running on a microprocessor, and a firmware contest client.

231. An Internet-based method for enabling a plurality of bidders to compete fairly in a bidding process for an item to auctioned over the Internet in accordance with a computer-administrated auction process involving the use of an auction server and a plurality of client machines competing in a bidding process, said auction server having a local clock and a GPS receiver for producing time-stamps referenced to a master clock, and each said client machine having a display device for displaying bid information, an input device for inputting bid information, and a GPS receiver for producing time-stamps referenced to said master clock, for application to information including bids input to said client machine, said Internet-based method comprising the steps of:

(a) said auction server transmitting encrypted bid information to each said client machine, and each said client machine storing said encrypted bid information for substantially simultaneous display on each said client machine at a predetermined globally-referenced start-time.

232. The Internet-based method of claim 231, which further comprises:

(b) ascertaining at each said client machine, the locally-referenced start-time of the bid process expressed in terms of the local clock at said client machine

233. The Internet-based method of claim 232, which further comprises:

(c) at each said client machine, aligning the display time of the encrypted bid information with said locally-referenced start-time.

234. The Internet-based method of claim 233, which further comprises:

(d) at said predetermined globally-referenced start-time, said auction server starts the bidding process for the item to be auctioned, by enabling the decryption of said bid information and simultaneous display thereof on each said client machine competing in the bidding process.

235. The Internet-based method of claim 234, which further comprises:

(e) said auction server accepting bids from said client machines for the item that are time-stamped after t_1.

236. The Internet-based method of claim 235, which further comprises:

(f) each said client machine competing in the bidding process, sending a bid for the item to said auction server and time-stamping the time of transmission of the bid using said local clock at said auction server which has been characterized using said GPS at said auction server.

237. The Internet-based method of claim 236, which further comprises:

(g) said auction server receiving the bid from each said client machine competing in the bidding process and sending a bid at step (f) and time-stamping the time of receipt of the bid using said local clock at said auction server which has been characterized using said GPS receiver at said auction server.

238. The Internet-based method of claim 237, which further comprises:

(h) said auction server sending to each said client machine competing in the bidding process, a confirmation of the bid receipt containing the time-stamps applied at both the time of transmission and the time of receipt of the bid.

239. The Internet-based method of claim 238, which further comprises:

(i) said auction server updating all client machines competing in the bidding process with the highest bid information for the item;

(i) continuing the operations set forth at steps (c) and (d) until said auction server no longer receives any bids from any competing client machines for a first predetermined amount of time (e.g. x seconds); and

(j) said auction server sending all competing client machines a notice of final bids at time t_4 .

240. The Internet-based method of claim 239, which further comprises:

(k) said auction server waiting a second predetermined time period (i.e. y seconds) for a new bid from any client machine competing in the bidding process;

(l) at t_4 + y seconds, said auction server closes the bidding process; and

(m) said auction server waiting z seconds for receipt of any bids from any of said client machines, time-stamped prior to t_4 = y seconds.

241. The Internet-based method of claim 231, which further comprises:

(n) said auction server determining whether a new higher bid has been received from any client machines competing in the bidding process, and if so, then returning to Step (f); and

(o) if said auction server determines that at step (l) that no higher bids have been received, then said auction server determines that the item is sold to the competing machine transmitting the highest bid (i.e. the highest bidder), and then said auction server updates all said client machines with the final sales price at which the item has been sold.

242. The Internet-based method of claim 231, wherein said item is an article of value selected from the group consisting of antiques, financial securities (e.g. stocks and bonds), options, futures, commodities, foreign currency, consumer goods, personal articles and effects, real estate including tracts of land as well as condominiums, licenses to use intangible properties (e.g. bands of the electromagnetic spectrum, patents, etc.), transferable club memberships and subscriptions, and the like.

243. The Internet-based method of claim 231, wherein said item comprises multiple items in a multi-item combinatorial auction.

244. The Internet-based method of claim 231, wherein one or more of said client machines competing in said bidding process include intelligent software

enabling each said client machine to programmably engage in said bidding process with a reduced level of human participation.

245. An Internet-based system for enabling a plurality of bidders to compete fairly in a bidding process for an item to be auctioned over the Internet in accordance with computer-administrated auction process, said Internet-based system comprising:

an auction server having a local clock and a GPS receiver for producing time-stamps referenced to a master clock; and

a plurality of client machines, each said client machine being assigned to one bidder competing in the bidding process, and each said client machine having a display device for displaying bid information, an input device for inputting bid information, and a GPS receiver for producing time-stamps referenced to said master clock, for application to information including bids input to said client machine.

246. The Internet-based system of claim 245, wherein said computer-administrated auction process comprising the steps of:

(a) said auction server transmitting encrypted bid information to each said client machine, and each said client machine storing said encrypted bid information for substantially simultaneous display on each said client machine at a predetermined globally-referenced start-time.

247. The Internet-based system of claim 246, wherein said computer-administrated auction process further comprises:

(b) ascertaining at each said client machine, the locally-referenced start-time of the bid process expressed in terms of the local clock at said client machine

248. The Internet-based system of claim 247, wherein said computer-administrated auction process further comprises:

(c) at each said client machine, aligning the display time of the encrypted bid information with said locally-referenced start-time.

249. The Internet-based system of claim 248, wherein said computer-administrated auction process further comprises:

(d) at said predetermined globally-referenced start-time, said auction server starts the bidding process for the item to be auctioned, by enabling the

decryption of said bid information and simultaneous display thereof on each said client machine competing in the bidding process.

250. The Internet-based system of claim 251, wherein said computer-administrated auction process further comprises:

(e) said auction server accepting bids from said client machines for the item that are time-stamped after t_1.

251. The Internet-based system of claim 250, wherein said computer-administrated auction process further comprises:

(f) each said client machine competing in the bidding process, sending a bid for the item to said auction server and time-stamping the time of transmission of the bid using said local clock at said auction server which has been characterized using said GPS at said auction server.

252. The Internet-based system of claim 251, wherein said computer-administrated auction process further comprises:

(g) said auction server receiving the bid from each said client machine competing in the bidding process and sending a bid at step (f) and time-stamping the time of receipt of the bid using said local clock at said auction server which has been characterized using said GPS receiver at said auction server.

253. The Internet-based system of claim 252, wherein said computer-administrated auction process further comprises:

(h) said auction server sending to each said client machine competing in the bidding process, a confirmation of the bid receipt containing the time-stamps applied at both the time of transmission and the time of receipt of the bid.

254. The Internet-based system of claim 253, wherein said computer-administrated auction process further comprises:

(i) said auction server updating all client machines competing in the bidding process with the highest bid information for the item;

(i) continuing the operations set forth at steps (c) and (d) until said auction server no longer receives any bids from any competing client machines for a first predetermined amount of time (e.g. x seconds); and

(j) said auction server sending all competing client machines a notice of final bids at time t_4 .

255. The Internet-based system of claim 254, wherein said computer-administrated auction process further comprises:

(k) said auction server waiting a second predetermined time period (i.e. y seconds) for a new bid from any client machine competing in the bidding process;

(l) at t_4 + y seconds, said auction server closes the bidding process; and

(m) said auction server waiting z seconds for receipt of any bids from any of said client machines, time-stamped prior to t_4 = y seconds.

256. The Internet-based system of claim 255, wherein said computer-administrated auction process further comprises:

(n) said auction server determining whether a new higher bid has been received from any client machines competing in the bidding process, and if so, then returning to Step (f); and

(o) if said auction server determines that at step (l) that no higher bids have been received, then said auction server determines that the item is sold to the competing machine transmitting the highest bid (i.e. the highest bidder), and then said auction server updates all said client machines with the final sales price at which the item has been sold.

257. The Internet-based system of claim 245, wherein said item is an article of value selected from the group consisting of antiques, financial securities (e.g. stocks and bonds), options, futures, commodities, foreign currency, consumer goods, personal articles and effects, real estate including tracts of land as well as condominiums, licenses to use intangible properties (e.g. bands of the electromagnetic spectrum, patents, etc.), transferable club memberships and subscriptions, and the like.

258. The Internet-based system of claim 245, wherein said item comprises multiple items in a multi-item combinatorial auction.

259. The Internet-based system of claim 245, wherein one or more of said client machines competing in said bidding process include intelligent software enabling each said client machine to programmably engage in said bidding process with a reduced level of human participation.

260. An Internet-based method for enabling a plurality of traders to compete fairly in a trading process involving property to be purchased and sold over the

Internet in accordance with a computer-administrated trading process involving the use of a price quotation and trading server (i.e. trading server) and a plurality of client machines competing in a trading process, said trading server having a local clock and a GPS receiver for producing time-stamps referenced to a master clock, and each said client machine having a display device for displaying price information, an input device for inputting offer to trade information (including a description of the property, an indication to buy or sell, and a price offer), and a GPS receiver for producing time-stamps referenced to said master clock, for application to information including offer to trade information input to said client machine, said Internet-based method comprising the steps of:

(a) said trading server transmitting encrypted offer to trade information to each said client machine, and each said client machine storing said encrypted offer to trade information for substantially simultaneous display on each said client machine at a predetermined globally-referenced start-time.

261. The Internet-based method of claim 260, which further comprises:

(b) ascertaining at each said client machine, the locally-referenced start-time of the trading process expressed in terms of the local clock at said client machine

262. The Internet-based method of claim 261, which further comprises:

(c) at each said client machine, aligning the display time of the encrypted offer to trade information with said locally-referenced start-time.

263. The Internet-based method of claim 262, which further comprises:

(d) at said predetermined globally-referenced start-time, said trading server starts the trading process for the property being offered for trading, by enabling the decryption of said offer to trade information and simultaneous display thereof on each said client machine competing in the trading process.

264. The Internet-based method of claim 263, which further comprises:

(e) said trading server accepting offer to trade from said client machines for the item that are time-stamped after t_1.

265. The Internet-based method of claim 264, which further comprises:

(f) each said client machine competing in the trading process, sending a offer for trade an item of property to said trading server and time-stamping the

time of transmission of the offer for trade using said local clock at said trading server which has been characterized using said GPS at said trading server.

266. The Internet-based method of claim 265, which further comprises:

(g) said trading server receiving the offer for trade from each said client machine competing in the trading process and sending a offer for trade at step (f) and time-stamping the time of receipt of the offer for trade using said local clock at said trading server which has been characterized using said GPS receiver at said trading server.

267. The Internet-based method of claim 266, which further comprises:

(h) said trading server sending to each said client machine competing in the trading process, a confirmation of the offer for trade receipt containing the time-stamps applied at both the time of transmission and the time of receipt of the offer for trade.

268. The Internet-based method of claim 267, which further comprises:

(i) said trading server matching (i) offers to sell a particular item of property at a particular price with (ii) offers to buy the particular item of property at the particular process, and settling the trade for said particular item of property, and

(j) said trading server sending the client machines involved in said trade settlement, a notice of purchase and sale for the particular item of property.

269. The Internet-based method of claim 260, wherein said item of property is an article of value selected from the group consisting of antiques, financial securities (e.g. stocks and bonds), options, futures, commodities, foreign currency, consumer goods, personal articles and effects, real estate including tracts of land as well as condominiums, licenses to use intangible properties (e.g. bands of the electromagnetic spectrum, patents, etc.), transferable club memberships and subscriptions, and the like.

270. The Internet-based method of claim 260, wherein one or more of said client machines competing in said trading process include intelligent software enabling each said client machine to programmably engage in said trading process with a reduced level of human participation.

271. An Internet-based system for enabling a plurality of traders to compete fairly in a trading process for property to be purchased and sold over the

Internet in accordance with computer-administrated trading process, said Internet-based system comprising:

a price quotation and trading server (i.e. trading server) having a local clock and a GPS receiver for producing time-stamps referenced to a master clock; and

a plurality of client machines, each said client machine being assigned to one trader competing in the trading process, and each said client machine having a display device for displaying offer to trade information (including an identification of the property, an indication to buy or sell, and a price offer), an input device for inputting offer to trade information, and a GPS receiver for producing time-stamps referenced to said master clock, for application to information including offer to trade input to said client machine.

272. The Internet-based system of claim 271, wherein said computer-administrated trading process comprising the steps of:

(a) said trading server transmitting encrypted offer to trade information to each said client machine, and each said client machine storing said encrypted offer to trade information for substantially simultaneous display on each said client machine at a predetermined globally-referenced start-time.

273. The Internet-based system of claim 272, wherein said computer-administrated trading process further comprises:

(b) ascertaining at each said client machine, the locally-referenced start-time of the trading process expressed in terms of the local clock at said client machine

274. The Internet-based system of claim 273, wherein said computer-administrated trading process further comprises:

(c) at each said client machine, aligning the display time of the encrypted offer to trade information with said locally-referenced start-time.

275. The Internet-based system of claim 274, wherein said computer-administrated trading process further comprises:

(d) at said predetermined globally-referenced start-time, said trading server starts the trading process for the property being offered for trading, by enabling the decryption of said offer to trade information and simultaneous display thereof on each said client machine competing in the trading process.

276. The Internet-based system of claim 275, wherein said computer-administrated trading process further comprises:

(e) said trading server accepting offer to trade from said client machines for the item that are time-stamped after t_1.

277. The Internet-based system of claim 276, wherein said computer-administrated trading process further comprises:

(f) each said client machine competing in the trading process, sending a offer for trade for an item of property to said trading server and time-stamping the time of transmission of the offer for trade using said local clock at said trading server which has been characterized using said GPS at said trading server.

278. The Internet-based system of claim 277, wherein said computer-administrated trading process further comprises:

(g) said trading server receiving the offer for trade from each said client machine competing in the trading process and sending a offer for trade at step (f) and time-stamping the time of receipt of the offer for trade using said local clock at said trading server which has been characterized using said GPS receiver at said trading server.

279. The Internet-based system of claim 278, wherein said computer-administrated trading process further comprises:

(h) said trading server sending to each said client machine competing in the trading process, a confirmation of the offer for trade receipt containing the time-stamps applied at both the time of transmission and the time of receipt of the offer for trade.

280. The Internet-based system of claim 279, wherein said computer-administrated trading process further comprises:

(i) said trading server matching (i) offers to sell a particular item of property at a particular price with (ii) offers to buy the particular item of property at the particular process, and settling the trade for said particular item of property; and

(j) said trading server sending the client machines involved in said trade settlement, a notice of purchase and sale for the particular item of property.

281. The Internet-based system of claim 271, wherein said item of property is an article of value selected from the group consisting of antiques, financial

securities (e.g. stocks and bonds), options, futures, commodities, foreign currency, consumer goods, personal articles and effects, real estate including tracts of land as well as condominiums, licenses to use intangible properties (e.g. bands of the electromagnetic spectrum, patents, etc.), transferable club memberships and subscriptions, and the like.

282. The Internet-based system of claim 271, wherein one or more of said client machines competing in said trading process include intelligent software enabling each said client machine to programmably engage in said trading process with a reduced level of human participation.

283. An Internet-based system comprising:

a plurality of GSU-enabled client network devices wirelessly connected to the infrastructure of the Internet, each GSU-enabled client network device being carried on an object to be tracked along the time-space (TS) continuum, and said transmitting digitally-signed data packets containing time-space (TS) coordinate information regarding the TS coordinates of the object carried thereby; and

a TS-stamping based tracking server operably connected to the infrastructure of the Internet, for receiving the digitally-signed data packets from each said GSU-enabled client network device and processing said digitally-signed data packets so as to determine the TS coordinates of the object carried thereby, with respect to a globally referenced timing source and a globally referenced spatial coordinate system.

284. The Internet-based system of claim 283, which further comprises an Internet information for enabling owners and/or custodians of each said object to access the TS coordinate information determined by said TS-stamping base tracking server, for display and use.

285. An Internet-based system for reliably tracking the space-time trajectory of mobile objects using globally time-synchronized clocks, global positioning subsystems, and digital signature techniques carried out with hardware chips embedded within wireless client network devices carried by the objects being tracked.

286. The Internet-based system of claim 285, wherein time-space (TS) coordinate data is stored aboard each said wireless network device as it is generated and then periodically downloaded to a TS-stamping based tracking

server, eliminating the amount of time that said wireless client network device has to be on-line.

287. A wireless GSU-enabled client network device which has one or more biophysiological sensors, to enable remote monitoring of the vital signs of a living object being tracked.

288. A GSU-enabled client network device having input sensors and input devices selected from the group consisting of: temperature sensors, humidity sensors, light level sensors, chemical sensors, and other physical property sensors, CCD image capturing devices, sound sensing/pickup and recording devices, fingerprint sensing/detection devices and other biometric sensing devices, vibration sensors, radiation sensors, gas/vapor sensors, speech recognition devices, keypad input devices, graphics input devices, devices for detecting tampering of the GSU-enabled device and/or removal of the GSU from its associated object, and the like.

289. An Internet-based system for securing a region of physical space using a GSU-enabled client network device which comprises:

a CCD-based digital video camera or scanner for capturing images of a field of view of the camera or scanner,

wherein each captured image frame is accurately space-time stamped, and recorded on videotape or other digital recording medium.

290. The Internet-based system of claim 289, wherein said GSU-enabled client network device which further comprises

a sound recording device for recording sound within and about the field of view of the camera.

291. A system and method of serving and receiving information over the Internet in connection with time-constrained competitive processes, which avoids the problems of network latency, ensures microsecond "start-time" accuracy, and can determine winners in the competition within microsecond "finish-time" accuracy.

292. An Internet-based system for enabling time-constrained competition among a massive number of competitors while compensating for the variable network communication latencies experienced by client machines used by the competitors.

293. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein a simultaneous start-time is produced for each and every competitor involved in a particular competition regulated by the system.

294. An Internet-based system for fairly and securely enabling timed-constrained competitions using Internet information servers to synchronize the initial display of an invitation to respond (e.g. stock offer, query or problem) on a client machine by shifting the phase of the display refresh cycle.

295. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein the time delay between a displayed invitation to respond (e.g. stock price, bid offer, or query) and the transmitted response is precisely measured using the instruction counter in the client machine.

296. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein client-event timing accuracy is markedly improved by using a globally-synchronized hardware timing device at each client machine to time-stamp each competitor's response to an invitation to respond (ITR) displayed on the display screen of the client machine.

297. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein each client machine deployed therein is protected against intentional tampering through any means by the competitor using the client machine, or by any third party desiring to gain an unfair advantage over other competitors.

298. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, which employs a digital signature method to protect against intentional tampering through any means by a competitor or third party, either intended to disrupt the operation of the competition and otherwise interfere with the enjoyment of other competitors or spectators.

299. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein the digital signature method employs a secret key, stored within a global synchronization unit (GSU) in each

client machine, in order to create the signature for both time-space stamping and to a hash value generated from the data.

300. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein the digital signature can be used to prove that the data (i.e. time-space stamp plus a hash of input data) has not been altered, and to prove that it originated from the holder of the secret key (located within the GSU).

301. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein each client machine employs a GSU, which combines GPS and digital data signature technology to provide a secure and verifiable time-space stamp on each client machine response.

302. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, which is scalable or extensible and capable of simultaneously supporting a multiplicity of competitions, each involving a virtually unlimited number (e.g. millions) of competitors.

303. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, which protects against clock device tampering at each client machine by utilizing and comparing multiple clock systems employed in each client machine.

304. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein each client machine in the system is provided with a client-based hardware extension to improve clock accuracy and precision and therefore improve client- event response characteristics at each such client machine.

305. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein each client machine in the system is provided with a client-based hardware extension to improve security by means of hardware encryption and decryption.

306. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein varying degrees of simultaneity can be offered, insuring that the start time on all client machines is

simultaneous within tens of milliseconds at the least precise level, to on the order of within a few microseconds when all of the measures provided for are used.

307. An Internet-based system for fairly and securely enabling timed-constrained competitions over the Internet, wherein one or more a globally-time synchronized Internet-based information servers simultaneously and securely communicate with millions of globally-time synchronized client machines engaged in a predetermined competition supported over the Internet.

308. An Internet-based method for fairly and securely enabling timed-constrained competitions over the Internet, wherein one or more a globally-time synchronized Internet-based information servers simultaneously and securely communicate with millions of globally-time synchronized client machines engaged in a predetermined competition supported over the Internet.

309. An Internet-based system, wherein each client machine is provided with a hardware device which can precisely time and space stamp an event, and thus securely generate an event only when specific time and space criteria are satisfied, and also verify the authenticity of previously generated time and space stamps produced by the hardware device.

310. An method of time-space stamping which can be used to authenticate electronic-commerce transactions between a vendor, bank and customer with microsecond time accuracy.

311. A system and method for electronically filing legal documents, such as patent applications, property transfer documents and court/litigation documents, with governmental or judicial institutions using the http, file transfer protocols (ftp), electronic data interchange (EDI) techniques, and/or any other file transmission protocols supported over the Internet.

312. A global time-synchronization unit for connection to or embedding within any client machine that is to be used in connection with the Internet-supported system and method of the present invention.

313. A global time-synchronization unit for connection to or embedding within any Internet information server that is to be used in connection with the Internet-supported system and method of the present invention.

314. A system and method of receiving information from securities (e.g. stocks and bonds), commodities and/or foreign currency information servers, representing real-time or "live" market conditions, and simultaneously disseminating such information to globally-synchronized client machines located world-wide to enable secure "on-line" electronic-based securities trading operations, commodities trading operations, and foreign currency trading operations in a fundamentally fair manner.

315. A system and method for electronic-based on-line securities trading, commodities trading, and foreign currency trading in a secure and fundamentally fair manner using client machines globally-synchronized with corresponding Internet-based securities trading servers, commodities trading servers, and foreign currency trading servers, respectively, so that each market competitor is informed about incremental changes in market conditions at substantially the same time and therefore is permitted to respond to such market condition changes (e.g. changes in stock, commodity or currency prices) at substantially the same time in accordance with principles of fundamental fairness and fair play.

316. An improved system and method of simultaneously disseminating securities, commodities, and/or foreign currency information (e.g. real-time price quotes) using globally time-synchronized information servers and client machines.

317. An Internet-based system and method which enables competitors to trade securities, commodities and/or foreign currencies using real-time pricing information that is disseminated to all competitors of a given level of service at substantially the same instant in time using a network of globally time-synchronized information servers and client machines.

318. An Internet-based information network, wherein competition supporting information servers (e.g. market price advertising servers and order execution servers) are time-synchronized with a plurality of globally-distributed time-synchronized client machines that can be preprogrammed so respond to real-time securities prices within micro-second client event accuracy by transmitting time and space stamped orders to purchase and/or sell securities, commodities and/or foreign currencies.

319. An Internet-based information network comprising server and client computer systems, wherebetween competition-promoting/supporting processes (e.g. bidding processes) are carried out among individuals over the Internet, and accurate time-stamping operations are performed at both the client and server ends of the network so that the response (i.e. bid) of each individual can be reliably accepted based upon its submission-time at the client computer system, and not upon the receipt-time thereof at the server computer system.

320. An Internet-based method of supporting competitive processes over the Internet using a network of server and client computer systems, wherebetween competition-promoting/supporting processes (e.g. bidding processes) are carried out among individuals over the Internet, wherein accurate time-stamping is performed at both the client and server ends of the competition-supporting process, so that the response (i.e. bid) can be reliably accepted based upon its submission-time at the client computer system, and not upon the receipt-time thereof at the server computer system.

321. An Internet-based system for enabling the embedding of a message within a transportable GSU-enabled computing device so that the message can only be decrypted in a specific location at a specific time period.

322. An Internet-based system comprising:

a plurality of GSU-enabled client network devices wirelessly connected to the infrastructure of the Internet, each GSU-enabled client network device being carried on an object to be tracked along the time-space (TS) continuum, and said transmitting digitally-signed data packets containing time-space (TS) coordinate information regarding the TS coordinates of the object carried thereby; and

a TS-stamping based tracking server operably connected to the infrastructure of the Internet, for receiving the digitally-signed data packets from each said GSU-enabled client network device and processing said digitally-signed data packets so as to determine the TS coordinates of the object carried thereby, with respect to a globally referenced timing source and a globally referenced spatial coordinate system.

323. The Internet-based system of claim 322, which further comprises an Internet information for enabling owners and/or custodians of each said object to access the TS coordinate information determined by said TS-stamping base tracking server, for display and use.

324. An Internet-based system for reliably tracking the space-time trajectory of mobile objects using globally time-synchronized clocks, global positioning subsystems, and digital signature techniques carried out with hardware chips embedded within wireless client network devices carried by the objects being tracked.

325. The Internet-based system of claim 324, wherein time-space (TS) coordinate data is stored aboard each said wireless network device as it is generated and then periodically downloaded to a TS-stamping based tracking server, eliminating the amount of time that said wireless client network device has to be on-line.

326. A wireless GSU-enabled client network device which has one or more biophysiological sensors, to enable remote monitoring of the vital signs of a living object being tracked.

327. A GSU-enabled client network device having input sensors and input devices selected from the group consisting of: temperature sensors, humidity sensors, light level sensors, chemical sensors, and other physical property sensors, CCD image capturing devices, sound sensing/pickup and recording devices, fingerprint sensing/detection devices and other biometric sensing devices, vibration sensors, radiation sensors, gas/vapor sensors, speech recognition devices, keypad input devices, graphics input devices, devices for detecting tampering of the GSU-enabled device and/or removal of the GSU from its associated object, and the like.

328. An Internet-based system for securing a region of physical space using a GSU-enabled client network device which comprises:

a CCD-based digital video camera or scanner for capturing images of a field of view of the camera or scanner,

wherein each captured image frame is accurately space-time stamped, and recorded on videotape or other digital recording medium.

329. The Internet-based system of claim 328, wherein said GSU-enabled client network device which further comprises

a sound recording device for recording sound within and about the field of view of the camera.

330. A system and method of serving and receiving information over the Internet in connection with time-constrained competitive processes, which avoids the problems of network latency, ensures microsecond "start-time" accuracy, and can determine winners in the competition within microsecond "finish-time" accuracy.

330. An Internet-based method of securing a computers communications network supporting a network computing device, said Internet-based method comprising the steps of:

(a) embodying a GSU chip into said network computing device so provide a GSU-enabled network computing device,

(b) programming the GSU chip in said GSU-enabled network computing device with a set of predetermined time and space (TS) coordinates so as to enable said GSU-enabled network computing device to access said communications network of subnetwork thereof (or WWW server connected thereto) only when said GSU-enabled network computing device is temporally and spatially present at said TS coordinates; and

c) disposing said GSU-enabled network computing device at said predetermined TS coordinates so as to automatically enable said GSU-enabled network computing device to access said communications network of subnetwork thereof (or WWW server connected thereto).

331. The Internet-based method of claim 330, wherein step (c) comprises said GSU transmitting a digitally-signed data package to a TS-stamping tracking server for receiving said digitally-signed data package and processing the same collect data indicative that said GSU-enabled network computing device is present at said predetermined TS coordinates and automatically transmitting a digitally-signed data package back to said GSU-enabled network computing device enabling said GSU-enabled network computing device to access said communications network of subnetwork thereof (or WWW server connected thereto).

332. An Internet-based method of securing a computers communications network supporting a network computing device, said Internet-based method comprising the steps of:

(a) embodying a GSU chip into said network computing device so provide a GSU-enabled network computing device, and

(b) programming the GSU chip in said GSU-enabled network computing device with a set of predetermined time and space (TS) coordinates so as to fully

enable said GSU-enabled network computing device to access said communications network of subnetwork thereof (or WWW server connected thereto) when said GSU-enabled network computing device is temporally and spatially present at said TS coordinates, and partially enable said GSU-enabled network computing device to partially access said communications network of subnetwork thereof (or WWW server connected thereto) when said GSU-enabled network computing device is not temporally and spatially present at said TS coordinates; and

(c) disposing said GSU-enabled network computing device outside of said predetermined TS coordinates so as to partially enable said GSU-enabled network computing device to partially access said communications network of subnetwork thereof (or WWW server connected thereto) so that a TS-stamping tracking server can track to the exact location of said GSU-enabled network computing device and authorities apprehend the person using the same without authorization.

333. An Internet-based system for enabling the embedding of a message within a transportable GSU-enabled computing device so that the message can only be decrypted in a specific location at a specific time period.

334. An Internet-based system for enabling the reception of secure radio communications by using a GSU-enabled client computing device of the present invention equipped, with radio communications capabilities, which is enabled by a TS-stamping based tracking receiver to only decrypt an particular incoming radio message or messages at a particular location at a particular period of time, and at no other space-time instant.

335. An Internet-based system for displaying information clues or instructions at particular instances along the space-time continuum, wherein a wireless GSU-enabled client network device (realized for example in the form of a watch or other portable casing having an integrated display screen and keypad) cooperates with a TS-stamping based tracking server through a global communication network so as to enable the GSU-enabled client network device to display information clues and/or instructions only when the GSU-enabled device is present within specific location over a particular time interval (i.e. intersects a prespecified region along the space-time continuum.

336. An Internet-based system for collecting space-time coordinates of an athlete or animal at particular instances along the space-time continuum,

wherein a wireless GSU-enabled client network device affixed (i.e. strapped) to the body of a human athlete (e.g. skier, runner or swimmer) or animal participating in sports competition, cooperates with a TS-stamping based tracking server through a global communication network so as to enable the GSU-enabled client network device to collect TS coordinate data during the competition, TD data is collected from the GSU-enabled device carried by the athlete on a real-time basis as the athlete or animal travels from point to point, along a predetermined course, and where collected TS data can be remotely analyzed to determine the performance of the athlete in the competition and determination of a winner.

337. An Internet-based method of and system for enabling the operation of set-top cable television boxes, and other digital media content delivery devices, in compliance with license agreements, wherein a GSU-enabled network computing device is embedded within each set-top cable television box, and other digital media content delivery device, in a media content delivery system, and one or more TS-stamping based tracking servers are used to track and control such media content delivery devices so that the media content delivery devices are enabled into operation only when such devices are in fact used in accordance with the conditions of use set forth in the license agreement with the customer (i.e. when used within the particular location specified in the license agreement and during the time duration thereof).

338. An Internet-based method of and system for enabling/controlling the operation any portable host system or device which is restricted to operate within a set of space-time constraints, by embedding a GSU-enabled device within each such portable host system or device, and using one or more TS-stamping based tracking servers to track and enable the operation of each such portable host system or device only when such systems and devices are in fact used in accordance with the conditions of use set forth in the license agreement.

339. An Internet-based method of and system for enabling/controlling the operation any portable host system, by embedding a GSU-enabled device within each such portable host system or device, and using one or more TS-stamping based tracking servers to track and enable or otherwise control particular functions within the host system based on its time-space coordinates.

340. An Internet-based system for securing a region of physical space, comprising:

a GSU-enabled client network device having a CCD-based digital video camera or scanner for capturing images of a field of view (FOV) of the camera or scanner, and/or a sound recording device for recording sound (tracks) within and about the field of view (FOV) of the camera.

wherein each captured image frame is accurately space-time stamped, and recorded on videotape or other digital recording medium associated with a RDBMS.

341. The Internet-based system of claim 340, which further comprises a Web-based owner/device registration server for registering owners (or custodians) of GSU-enabled devices.

342. The Internet-based system of claim 340, which further comprises a Web-based image monitoring server for allowing owners to view image/sound frames captured and stored in said RDBMS.

343. The Internet-based system of claim 340, which further comprises a Web-enabled client machines for carrying out such owner involved operations.

344. An Internet-based method of securing a computer communications network having a plurality of network computing devices, said method comprising the steps of:

(a) embodying a GSU device into each network computing device so that its access to a particular communications/computer network (i.e. subnetwork) or WWW site can be securely enabled by a TS-stamping tracking server only upon the generation of a unique time-space stamp by the GSU-chip corresponding to a predetermined location over which the GSU-enabled network computing device is enabled; and

(b) disposing said GSU-enabled network computing device at said predetermined location so that said GSU-enabled network computing device is enabled by said TS-Stamping Based Tracking Server to access a prespecified communication subnetwork or WW server.

345. An Internet-based method for securing a computers communications network by embodying a GSU chip, wherein a GSU-enabled network computing device which is used to access a particular communications (sub)network or WWW site, is partially enabled by the enabled the TS-stamping tracking server when the GSU-enabled network computing device is present outside of the predetermined location, or predetermined time interval, so that the TS-stamping

tracking server can track to the exact location of the GSU-enabled computing device and authorities apprehend the personal using the same without authorization.

346. An Internet-based system for tracking an object, said Internet-based system comprising:

a GSU carried on said object, for automatically generating TS coordinate data indicative of the TS coordinates of said object with reference to a global reference system; and

a TS-stamping tracking server, for communication with said GSU, and collecting the TS coordinates of said object as said object moves through the TS continuum, and storing said TS coordinates in memory for analysis and/or monitoring operations.

347. The Internet-based system of claim 346, wherein said object is a living being or animal, and said GSU further comprises a biometric sensor for sensing a vital signal of said living being, on which said GSU is being carried, and providing biometric data to said TS-stamping tracking server for collection and storage, and analysis and/or monitoring operations.

348. The Internet-based system of claim 346, which further comprises a Web-based owner/objet registration server for registering owners (or custodians) of said object.

349. The Internet-based system of claim 346, which further comprises a Web-based object trajectory monitoring server for allowing owners to monitor the TS trajectory of said object during tracking operations.

350. The Internet-based system of claim 346, which further comprises a Web-enabled client machines for carrying out such owner involved operations.

351. An Internet-based system for displaying information at particular instances along the space-time (TS) continuum, comprising:

a GSU-enabled client network device having a GSU, a display, and a wireless connection to the infrastructure to the Internet; and

a TS-stamping based tracking server operably connected to the infrastructure of the Internet, and communicating with said GSU so as to enable said GSU-enabled client network device to present said information to said

display only when said GSU-enabled client network device intersects a prespecified region along the space-time (TS) continuum.

352. The Internet-based system of claim 351, wherein said information is a encrypted radio message received by said GSU-enabled client network device

353. The Internet-based system of claim 351, wherein said GSU-enabled client network device is realized in the form of a watch or other portable casing having an integrated display screen and keypad.

354. The Internet-based system of claim 351, which further comprises a Web-based owner/device registration server for registering owners (or custodians) of said device.

355. The Internet-based system of claim 351, which further comprises a Web-based display monitoring server for allowing owners to monitor the display of said device.

356. The Internet-based system of claim 351, which further comprises a Web-enabled client machines for carrying out such owner involved operations.

357. An Internet-based system for displaying information at particular instances along the space-time (TS) continuum, comprising:

a GSU-enabled client network device having a GSU and a display; and

a TS-stamping based tracking server communicating with said GSU so as to enable said GSU-enabled client network device to present said information to said display only when said GSU-enabled client network device intersects a prespecified region along the space-time (TS) continuum.

358. The Internet-based system of claim 357, wherein said information is a encrypted radio message received by said GSU-enabled client network device.

359. The Internet-based system of claim 357, wherein said display is an audio display device.

360. The Internet-based system of claim 357, wherein said GSU-enabled client network device is realized in the form of a watch or other portable casing having an integrated display and keypad.

361. The Internet-based system of claim 357, which further comprises a Web-based owner/device registration server for registering owners (or custodians) of said device.

362. The Internet-based system of claim 357, which further comprises a Web-based display monitoring server for allowing owners to monitor the display of said device.

363. The Internet-based system of claim 357, which further comprises a Web-enabled client machines for carrying out such owner involved operations.

364. An Internet-based system for displaying information clues or instructions at particular instances along the space-time (TS) continuum, comprising:

a GSU-enabled client network device having a GSU, a display, and a wireless connection to the infrastructure to the Internet; and

a TS-stamping based tracking server operably connected to the infrastructure of the Internet, and communicating with said GSU so as to enable said GSU-enabled client network device to present said information clues and/or instructions to said display only when said GSU-enabled client network device intersects a prespecified region along the space-time (TS) continuum.

365. The Internet-based system of claim 364, wherein said GSU-enabled client network device is realized in the form of a watch or other portable casing having an integrated display screen and keypad.

366. The Internet-based system of claim 364, which further comprises a Web-based owner/device registration server for registering owners (or custodians) of said device.

367. The Internet-based system of claim 364, which further comprises a Web-based display monitoring server for allowing owners to monitor the display of said device.

368. The Internet-based system of claim 364, which further comprises a Web-enabled client machines for carrying out such owner involved operations.

369. An Internet-based system for enabling the operation of a transportable digital media content delivery device, in a media content delivery system, comprising:

a GSU device embedded within said transportable digital media content delivery device, for automatically generating TS coordinate data indicative of the TS coordinates of said transportable digital media content delivery device, with reference to a global reference system; and

a TS-stamping tracking server, for communication with said GSU, and collecting the TS coordinates of said object as said object moves through the TS continuum, and enabling the operation of said transportable media content delivery device only when said transportable digital media content delivery device is present within the particular region of said time-space (TS) continuum.

370. The Internet-based system of claim 369, wherein said transportable digital media content delivery device is a set-top television box.

371. The Internet-based system of claim 369, which further comprises a Web-based owner/device registration server for registering owners (and/or licensed users) of said transportable digital media content delivery device.

372. The Internet-based system of claim 369, which further comprises a Web-based device monitoring server for allowing owners to monitor the TS trajectory of said transportable digital media content delivery device.

373. The Internet-based system of claim 369, which further comprises a Web-enabled client machines for carrying out such owner involved operations.

ABSTRACT OF DISCLOSURE

An improved system and method of fairly and securely enabling time-constrained competitions over the Internet among millions of competitors while compensating for the variable network communication latencies experienced by client machines used by the competitors. The system employs globally time-synchronized Internet information servers and client machines in order to synchronize the initial display of each invitation to respond (e.g. stock price to buy or sell, query to answer, or problem to solve) on a client machine so each competitor can respond to the invitation at substantially the same time, regardless of his or her location on the planet, or the type of Internet-connection used by his or her client machine. Also, by using globally time-synchronized client machines, each competitor's response is securely time and space stamped at the client machine to ensure that competitor responses are resolved within microsecond accuracy.

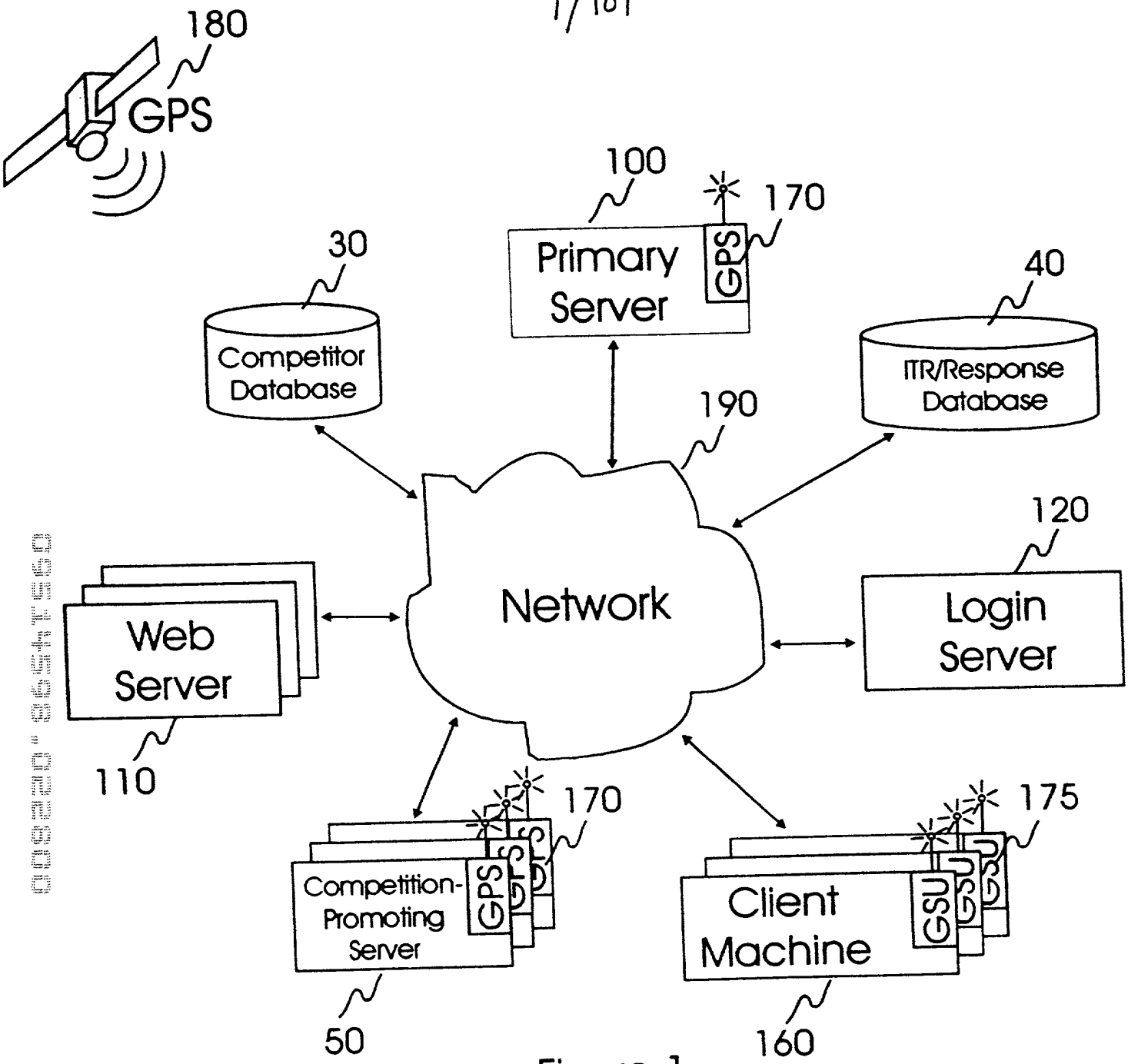


Figure 1

SUBSTITUTE SHEET (RULE 26)

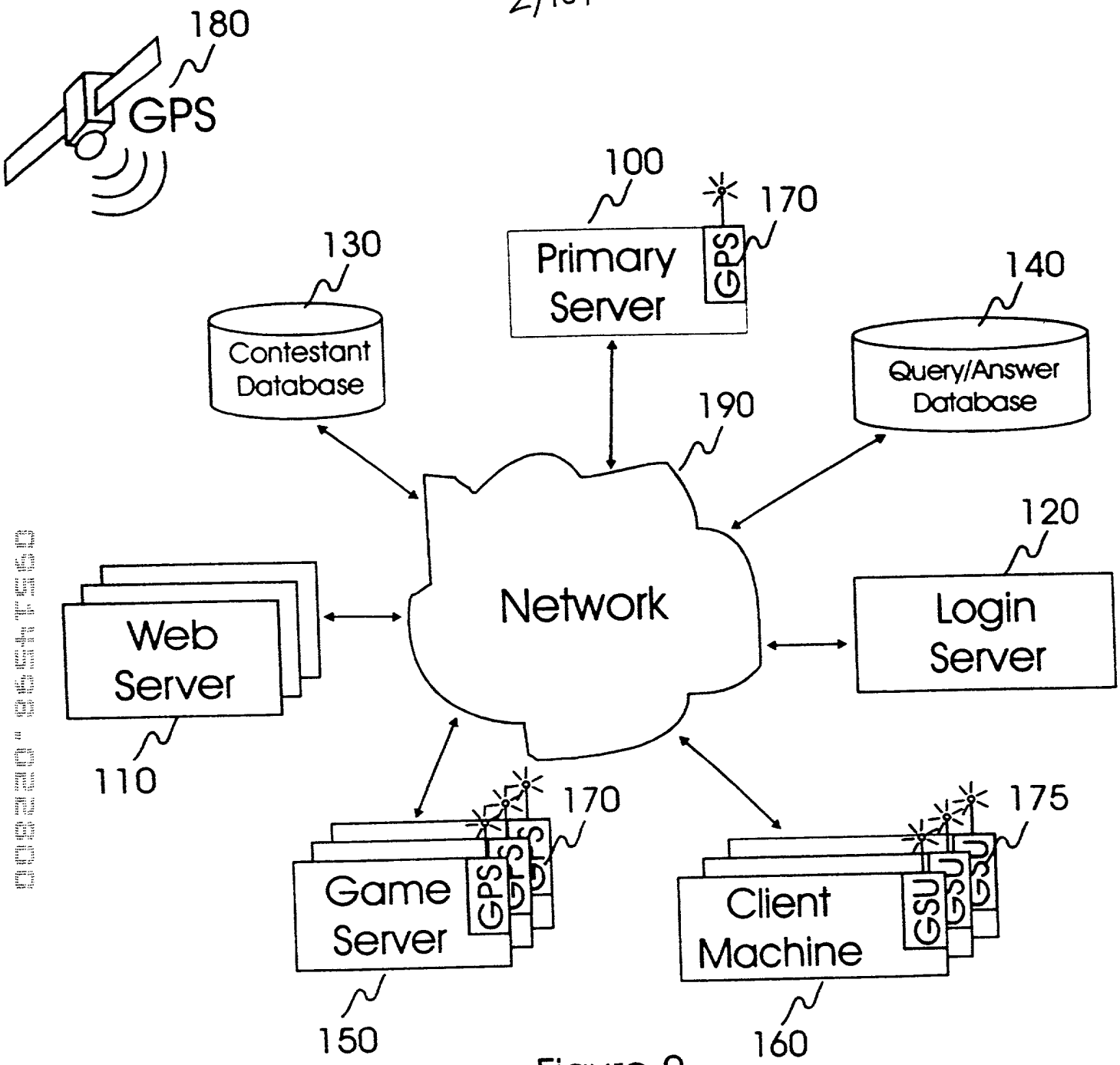

180
GPS
100
170
Primary Server
GPS
130
Contestant Database
140
Query/Answer Database
190
120
Network
Login Server
Web Server
110
170
Game Server
GPS
150
175
Client Machine
GSU
160

Figure 2

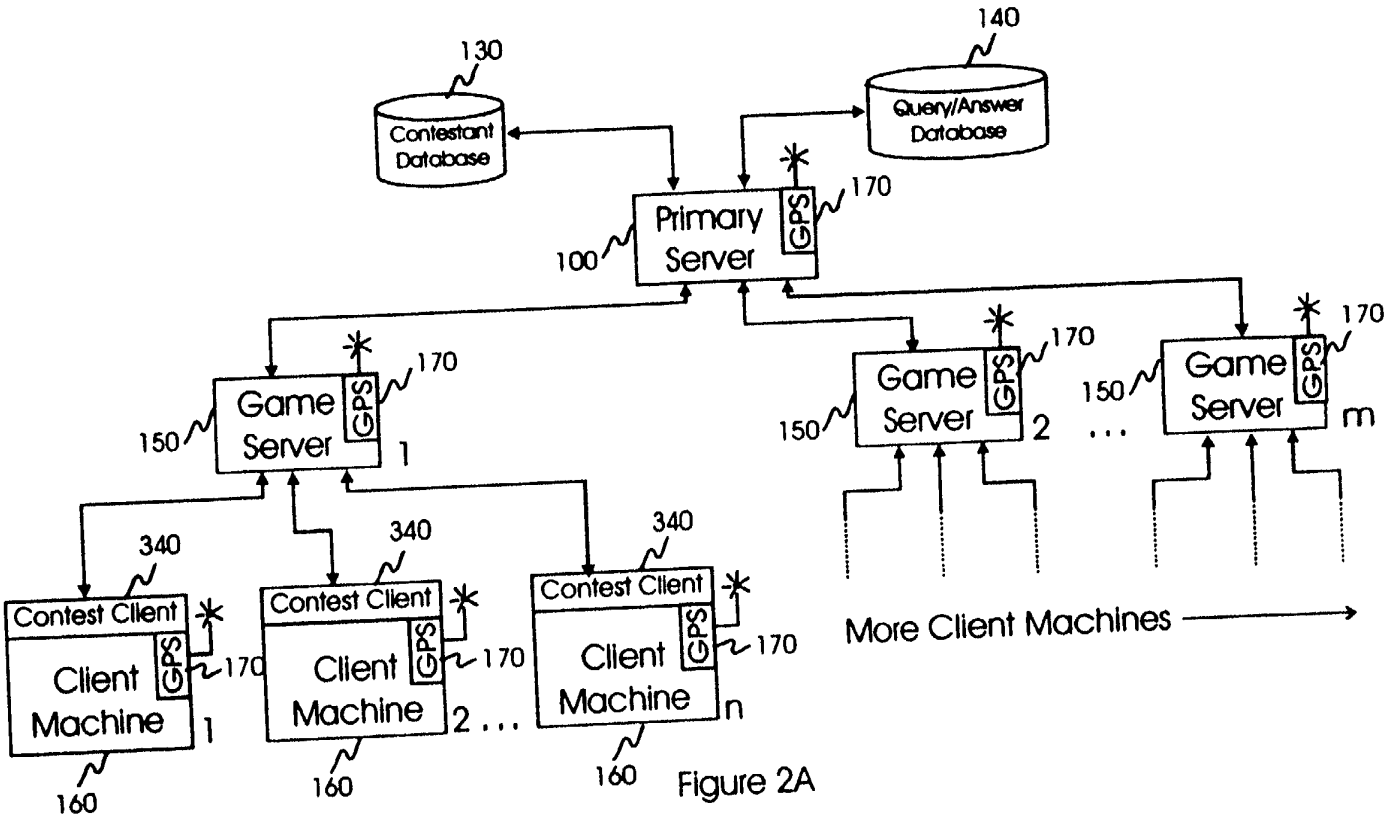

130
Contestant Database
140
Query/Answer Database
Primary Server
100
GPS
170
Game Server
150
1
2
m
Contest Client
Client Machine
340
160
More Client Machines

Figure 2A

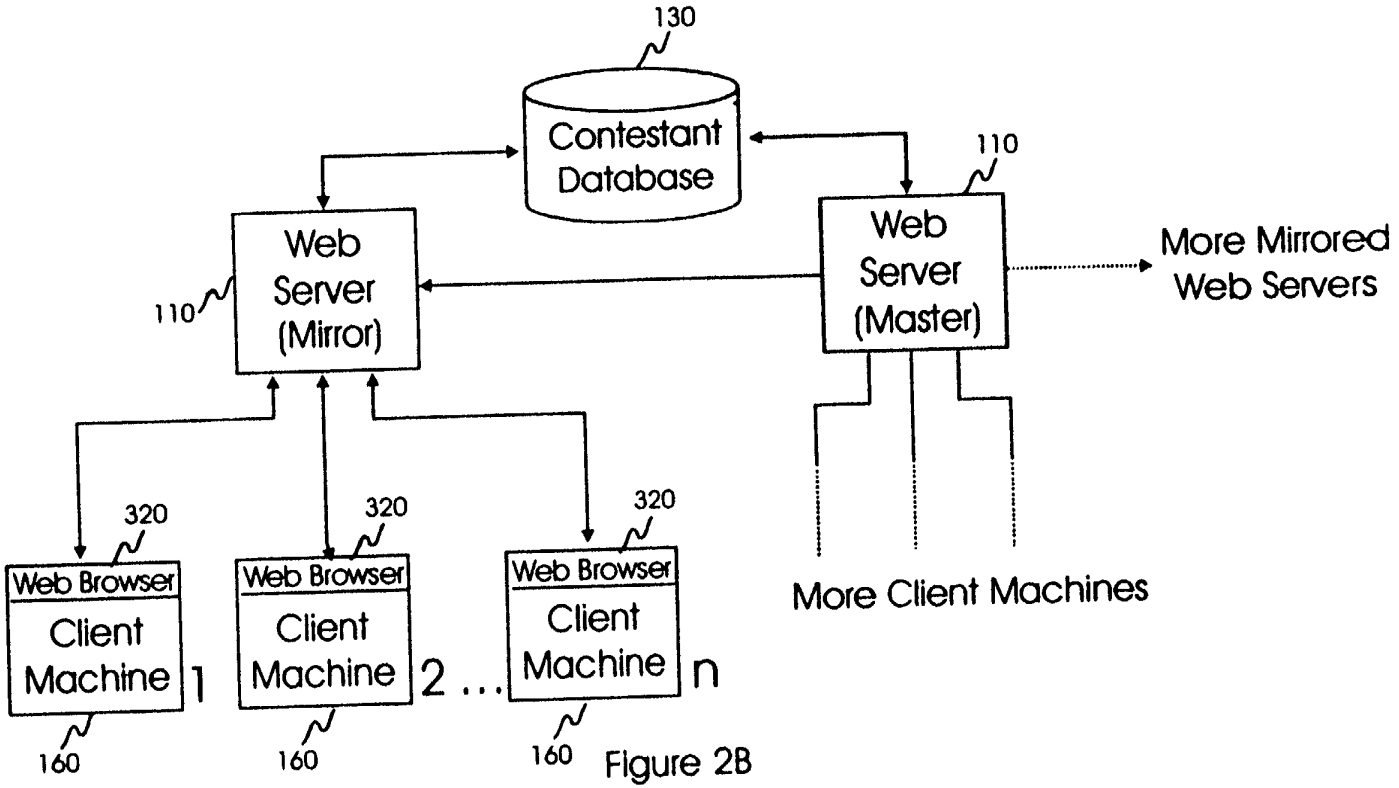

130
Contestant Database
110
Web Server (Mirror)
110
Web Server (Master)
More Mirrored Web Servers
320
320
320
Web Browser
Client Machine 1
Web Browser
Client Machine 2 ...
Web Browser
Client Machine n
160
160
160
More Client Machines

Figure 2B

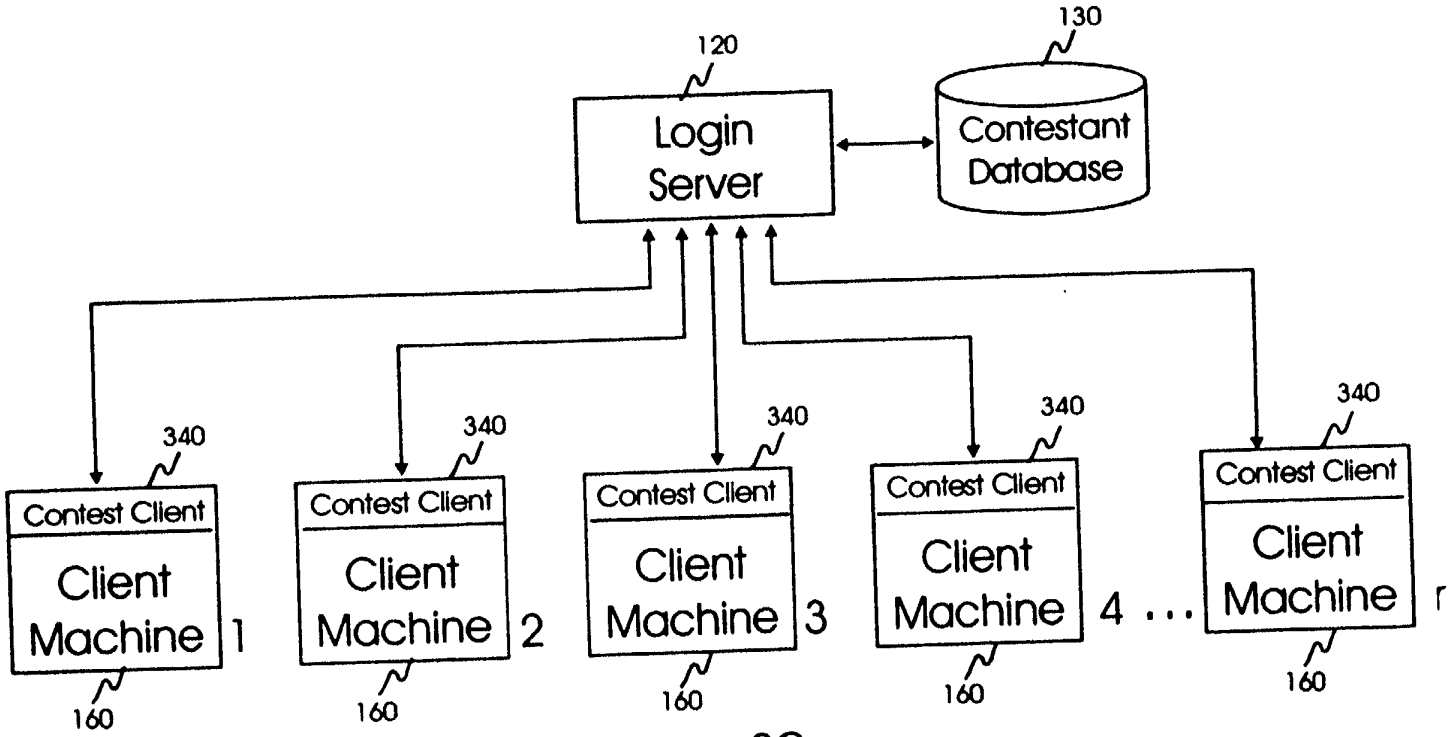

120
Login Server
130
Contestant Database
340
Contest Client
Client Machine
1
2
3
4
...
r
160

Figure 2C

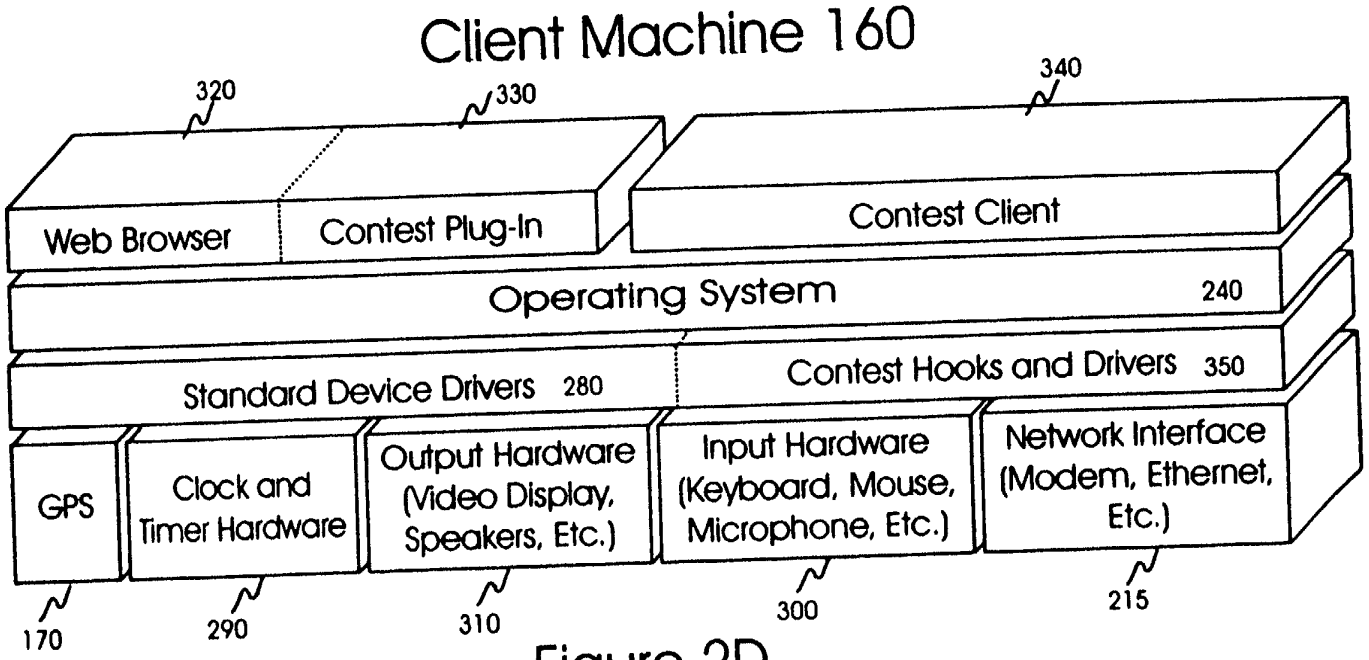

Client Machine 160
320
330
340
Web Browser
Contest Plug-In
Contest Client
Operating System
240
Standard Device Drivers 280
Contest Hooks and Drivers 350
GPS
Clock and Timer Hardware
Output Hardware (Video Display, Speakers, Etc.)
Input Hardware (Keyboard, Mouse, Microphone, Etc.)
Network Interface (Modem, Ethernet, Etc.)
170
290
310
300
215

Figure 2D

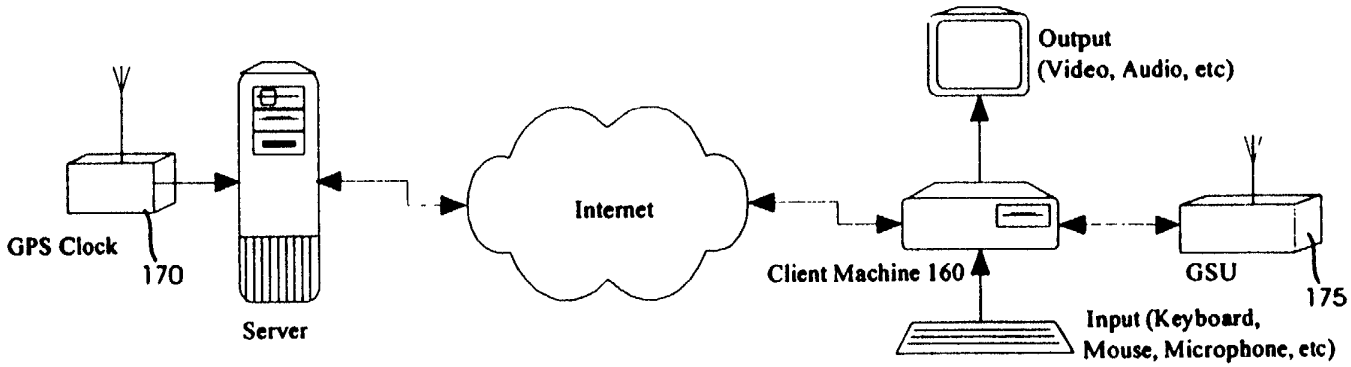

Output
(Video, Audio, etc)
GPS Clock
170
Server
Internet
Client Machine 160
GSU
175
Input (Keyboard,
Mouse, Microphone, etc)

Figure 2D1

Global Synchronization Unit 175

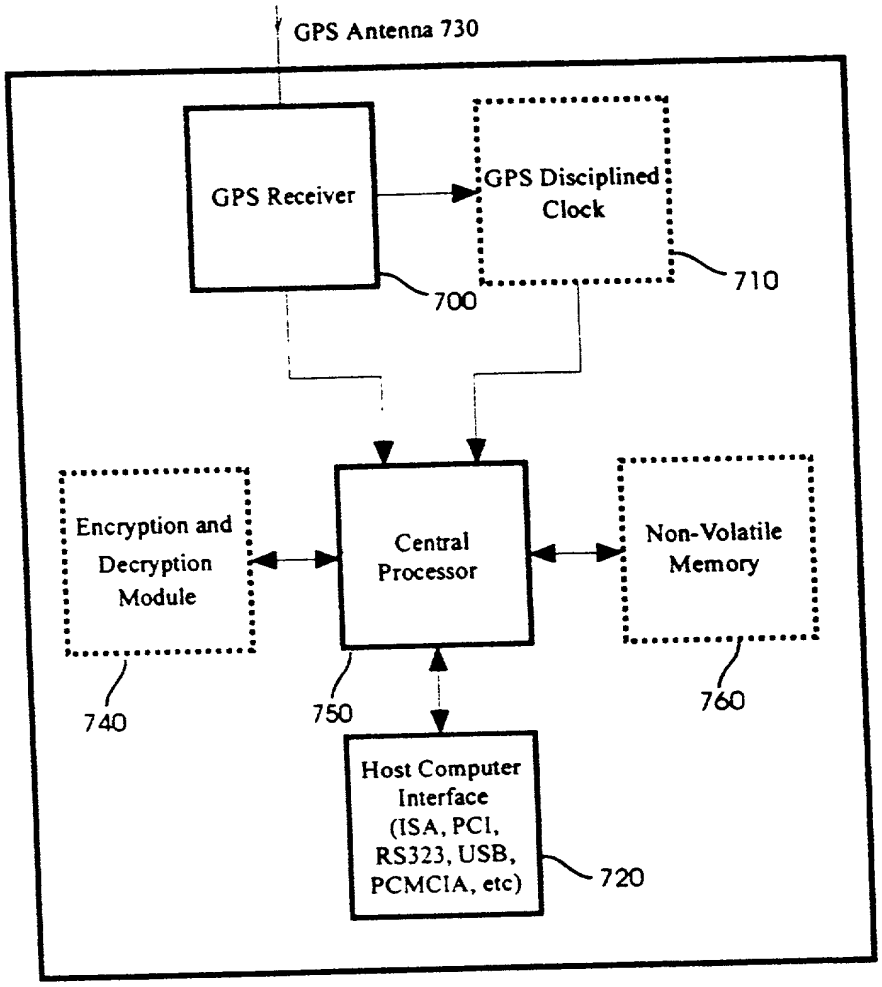


Figure 2D2

Docket No. 50277-2000

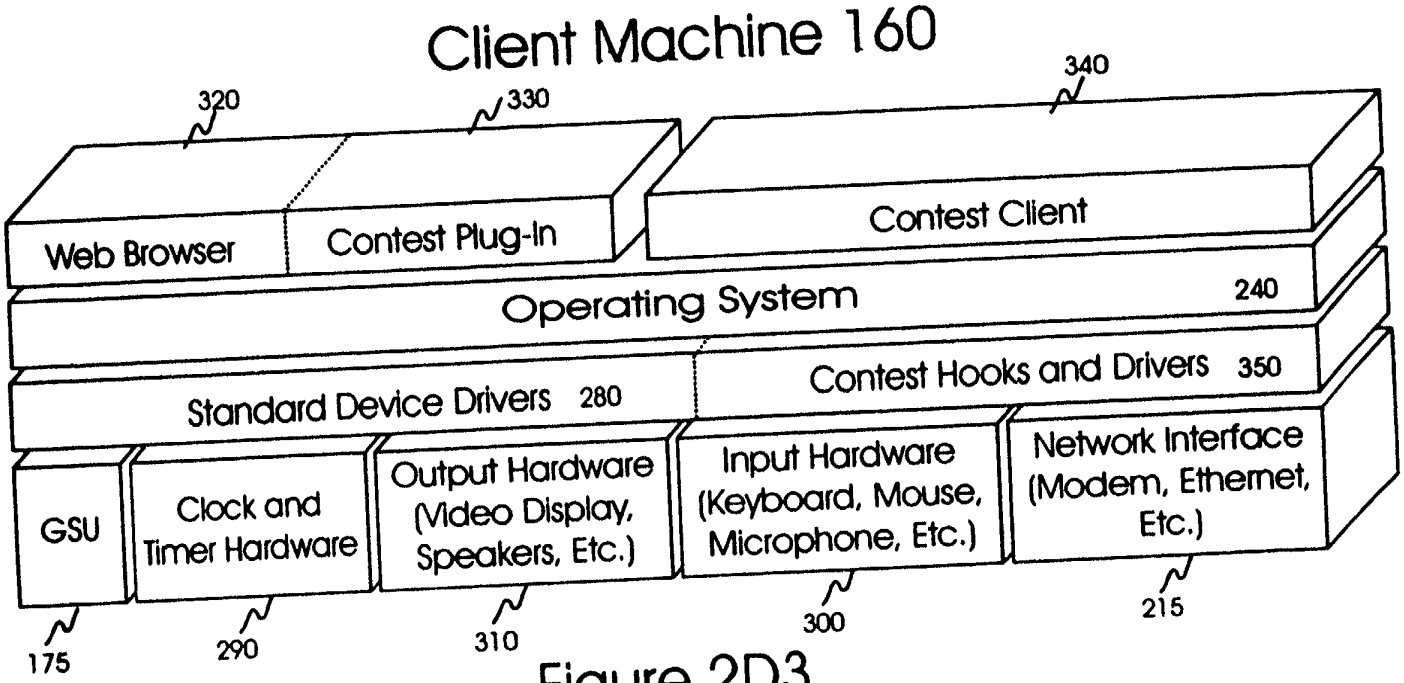

Client Machine 160
320
330
340
Web Browser
Contest Plug-In
Contest Client
Operating System
240
Standard Device Drivers 280
Contest Hooks and Drivers 350
GSU
Clock and Timer Hardware
Output Hardware (Video Display, Speakers, Etc.)
Input Hardware (Keyboard, Mouse, Microphone, Etc.)
Network Interface (Modem, Ethernet, Etc.)
175
290
310
300
215

Figure 2D3

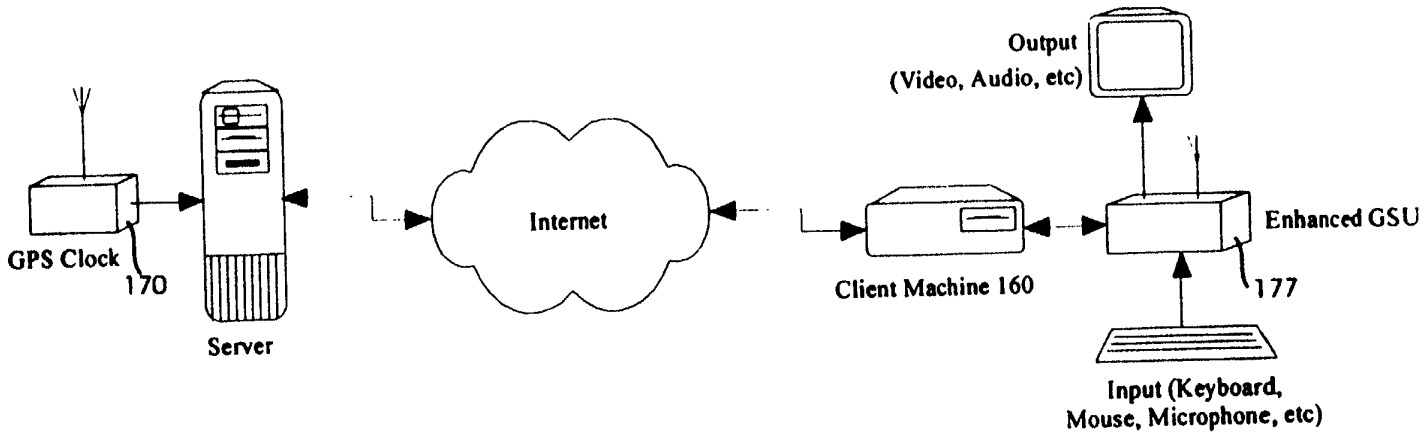

Output
(Video, Audio, etc)
GPS Clock
170
Server
Internet
Client Machine 160
Enhanced GSU
177
Input (Keyboard,
Mouse, Microphone, etc)

Figure 2D4

Enhanced Global Synchronization Unit 177

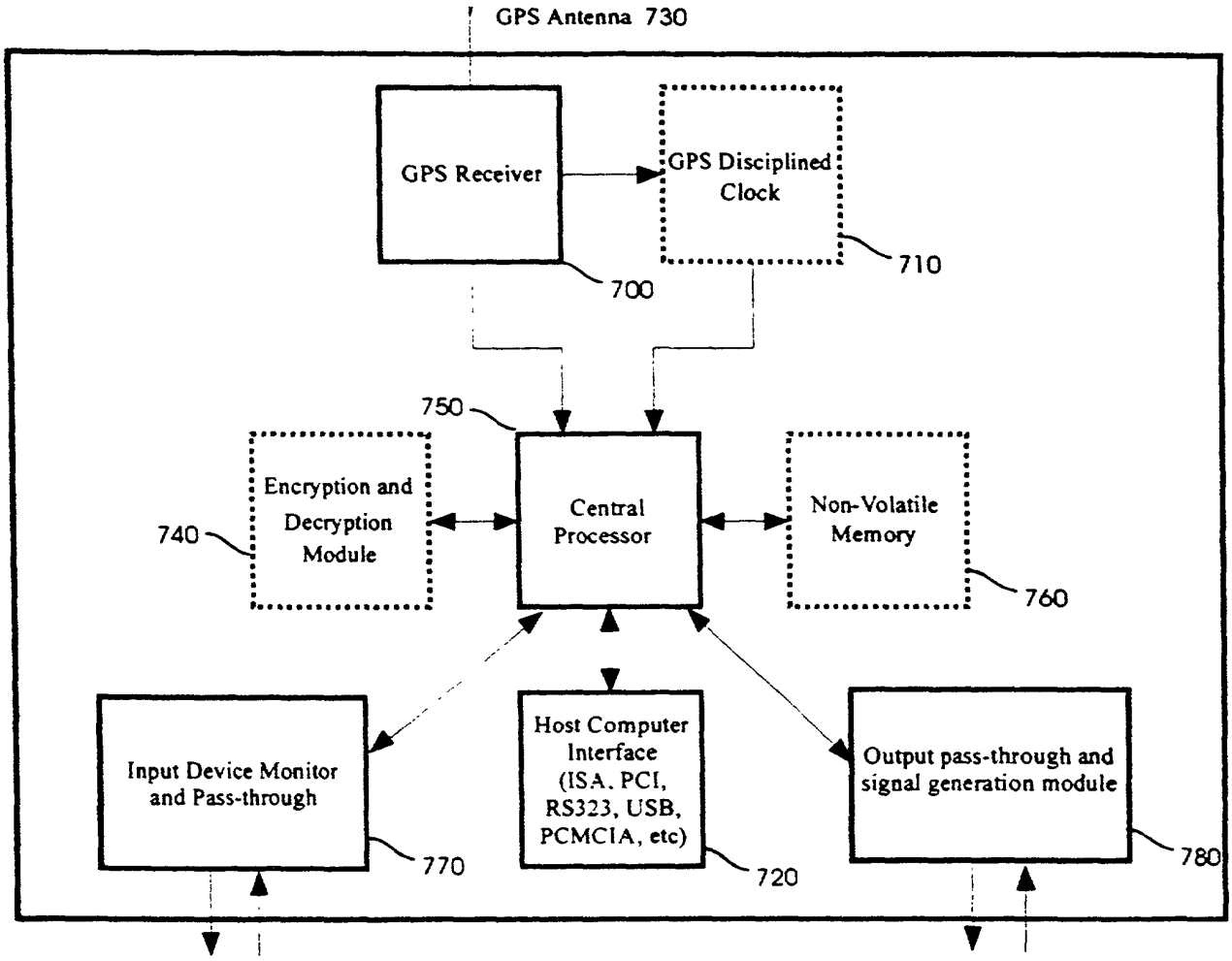


Figure 2D5

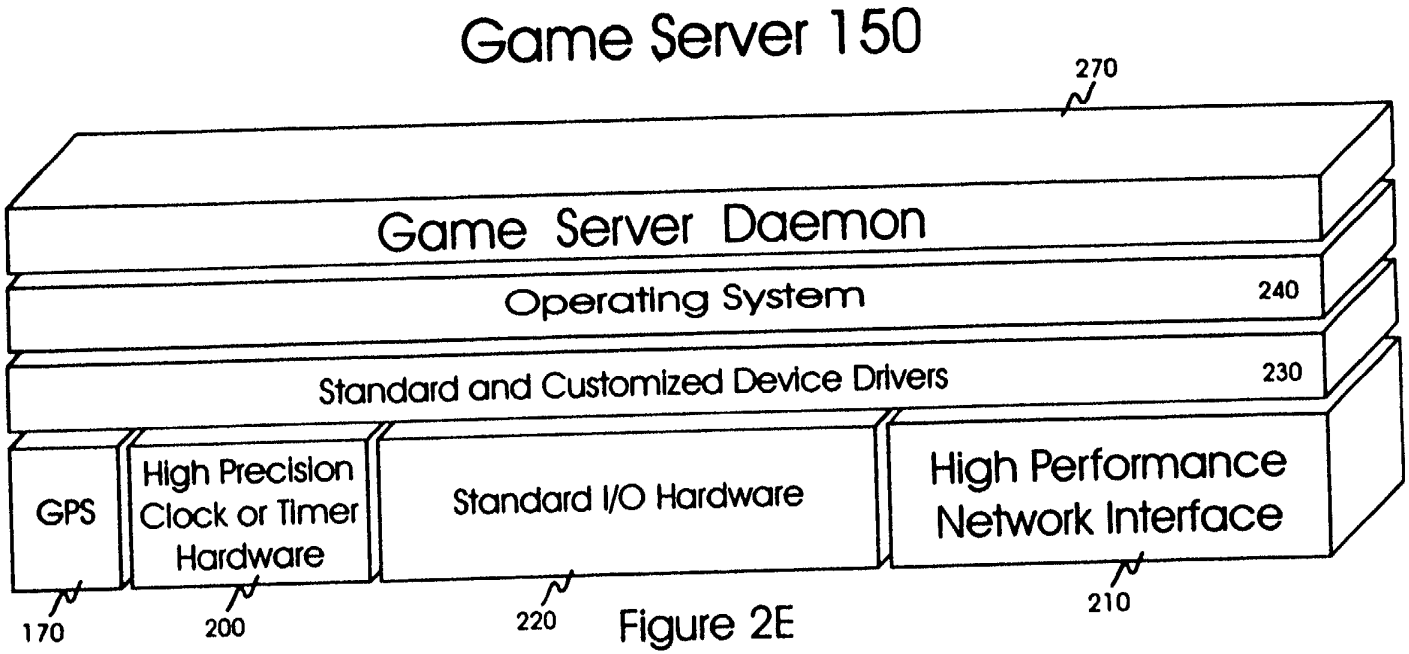

Game Server 150
270
Game Server Daemon
Operating System
240
Standard and Customized Device Drivers
230
GPS
High Precision Clock or Timer Hardware
Standard I/O Hardware
High Performance Network Interface
170
200
220
210

Figure 2E

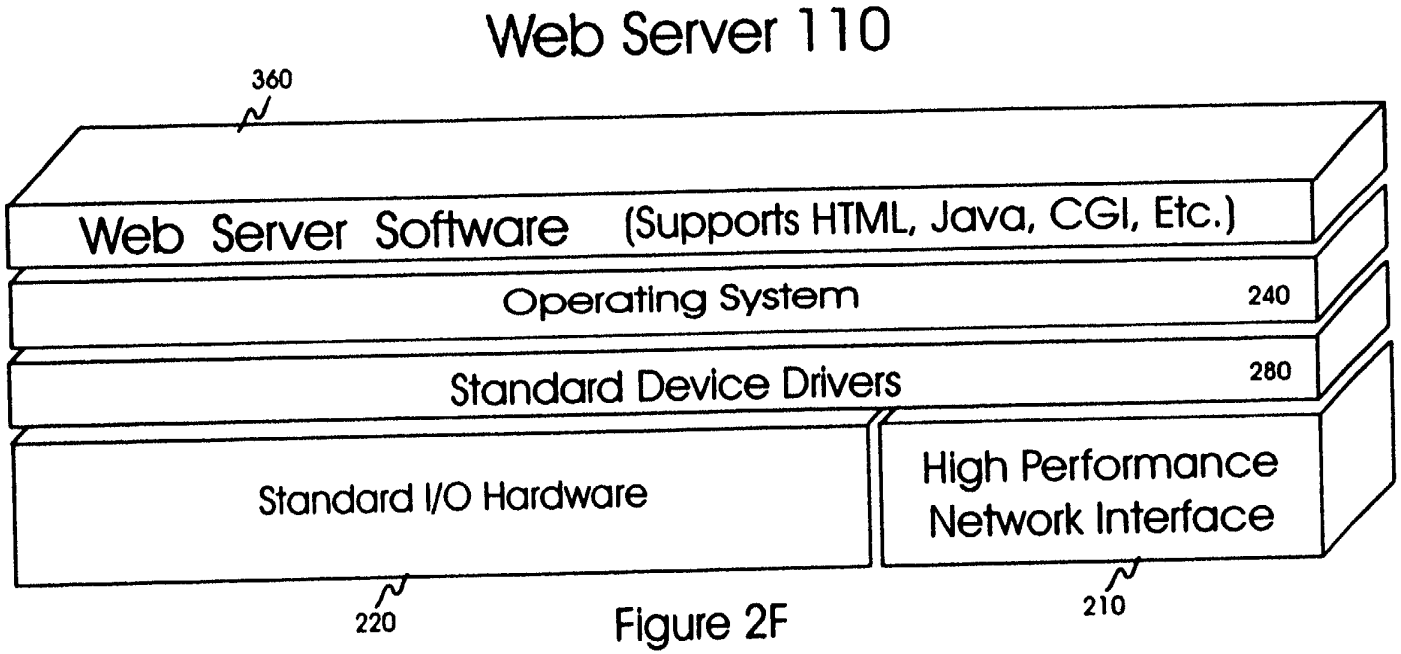

Web Server 110
360
Web Server Software (Supports HTML, Java, CGI, Etc.)
Operating System
240
Standard Device Drivers
280
Standard I/O Hardware
High Performance Network Interface
220
210

Figure 2F

09930 "9S6hTS60

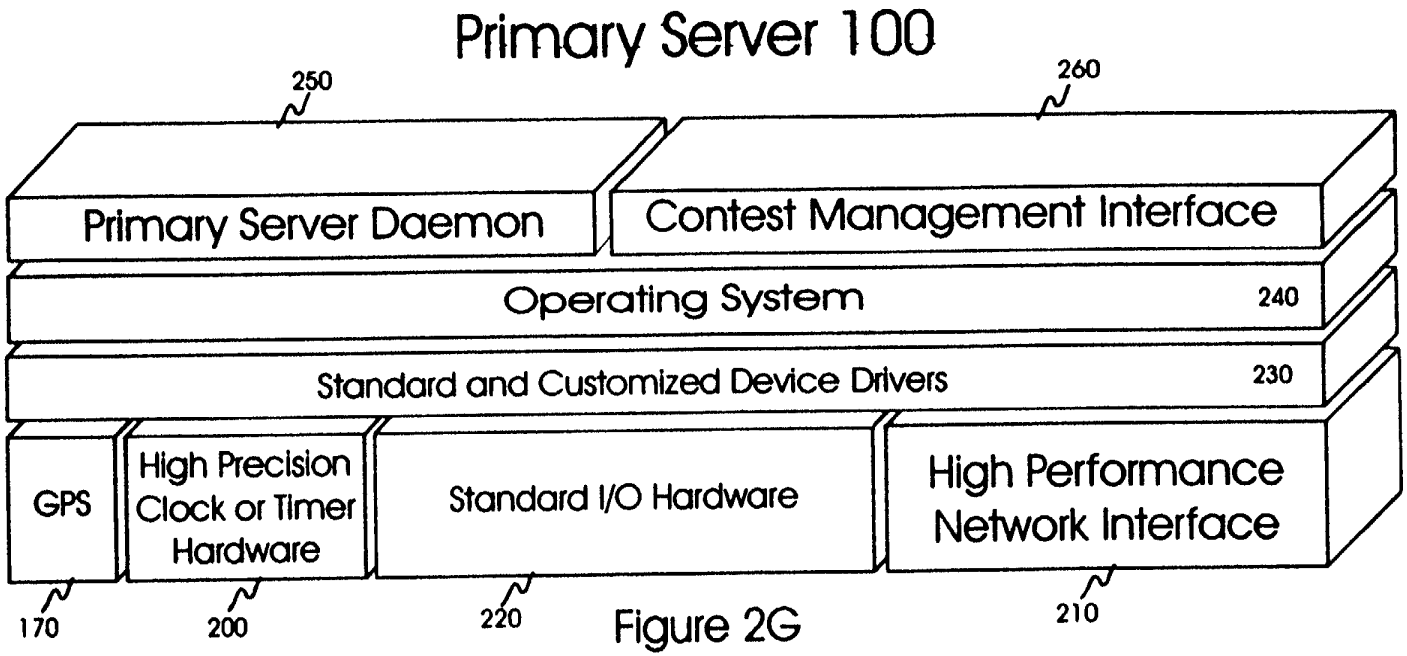


Figure 2G

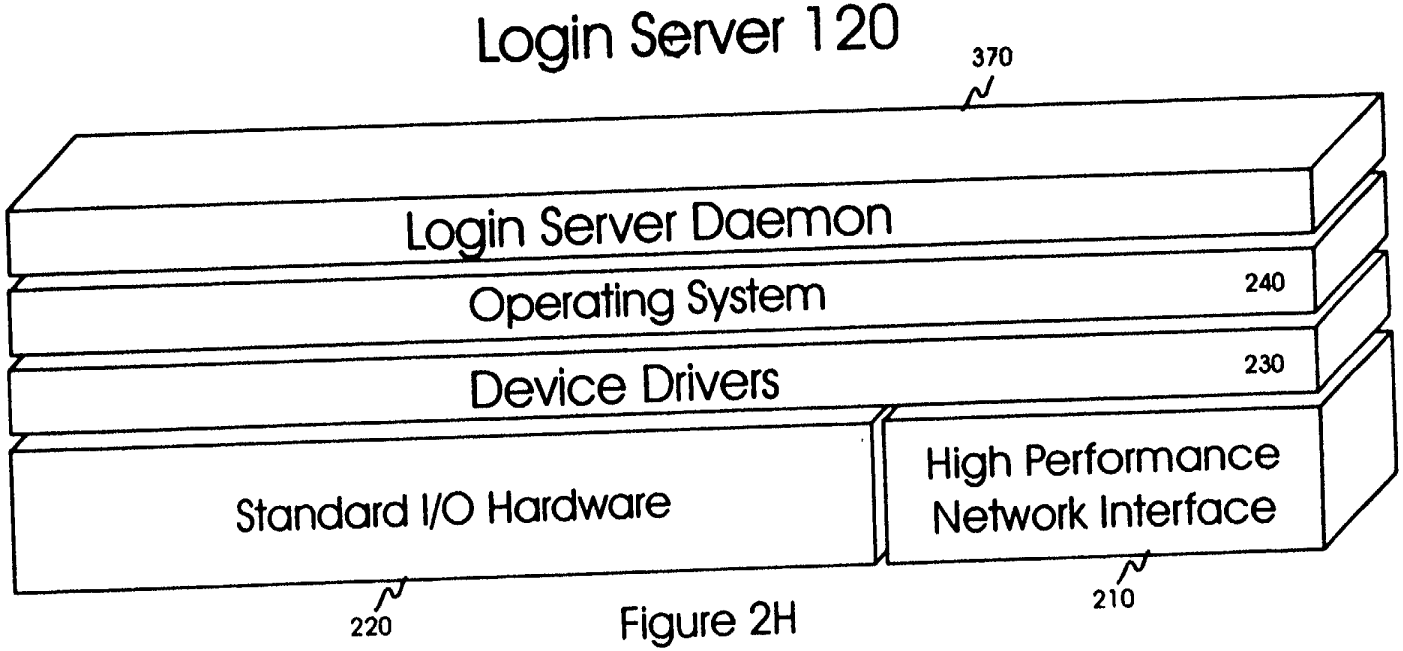

Login Server 120
370
Login Server Daemon
Operating System
240
Device Drivers
230
Standard I/O Hardware
High Performance
Network Interface
220
210

Figure 2H

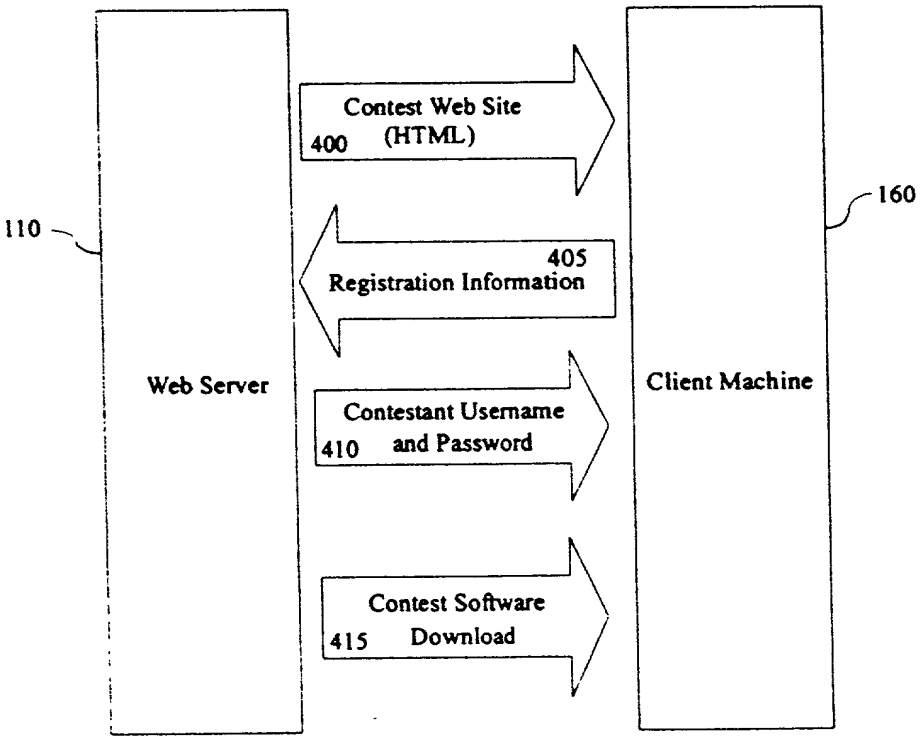


Figure 3A

SUBSTITUTE SHEET (RULE 26)

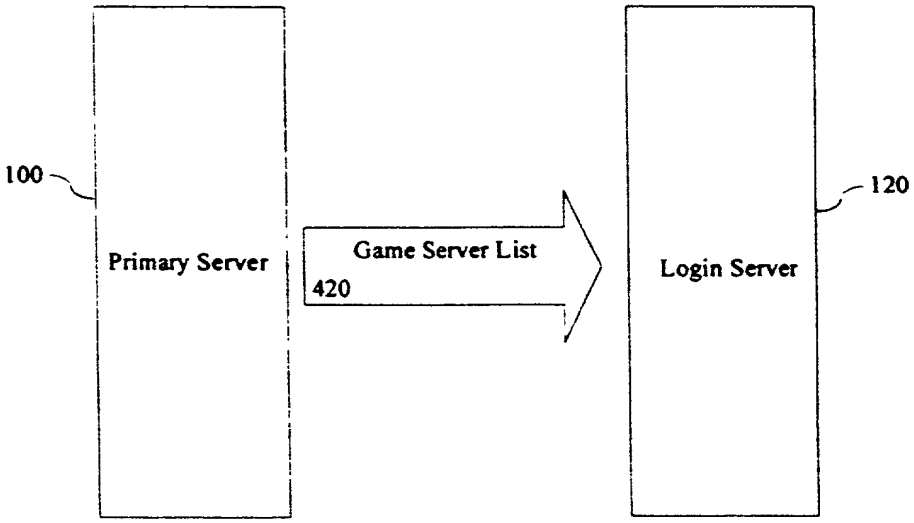


Figure 3B

Docket No. 20010-0003

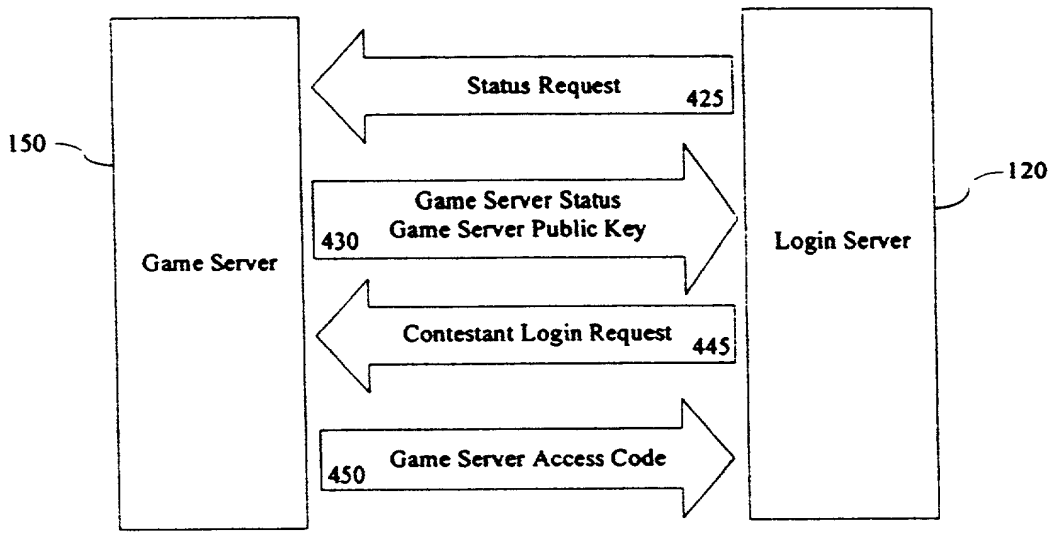


Figure 3C

Client-Server Gaming System

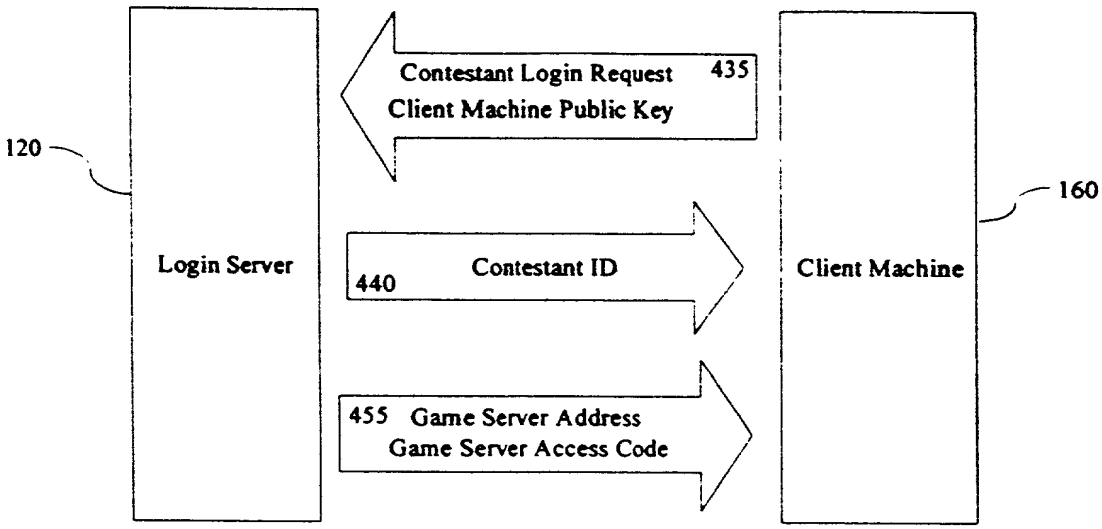

120
Login Server
Contestant Login Request
Client Machine Public Key
435
Contestant ID
440
455 Game Server Address
Game Server Access Code
Client Machine
160

Figure 3D

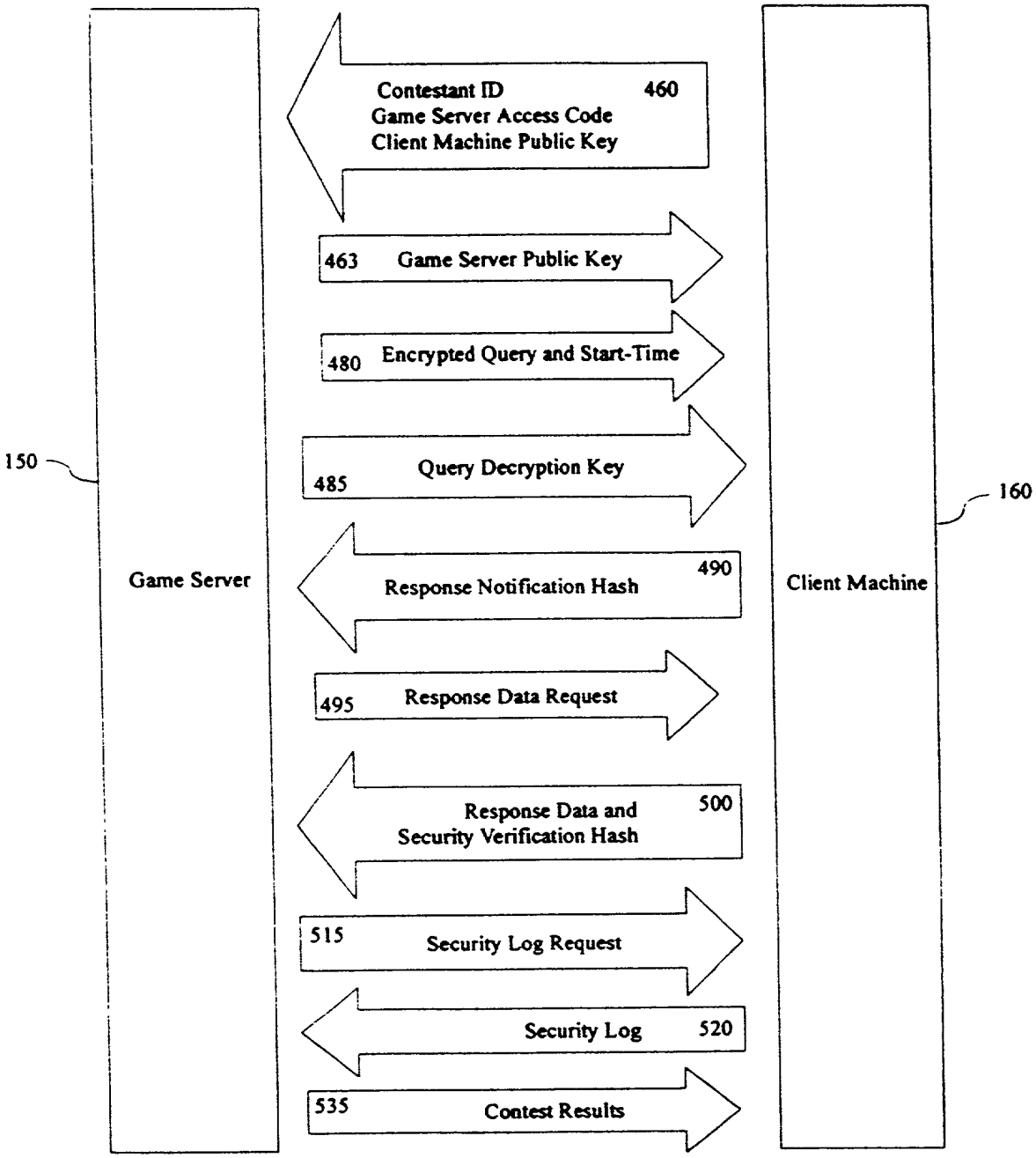

150
Game Server
160
Client Machine
Contestant ID
Game Server Access Code
Client Machine Public Key
460
463
Game Server Public Key
480
Encrypted Query and Start-Time
485
Query Decryption Key
490
Response Notification Hash
495
Response Data Request
500
Response Data and
Security Verification Hash
515
Security Log Request
Security Log
520
535
Contest Results

Figure 3E

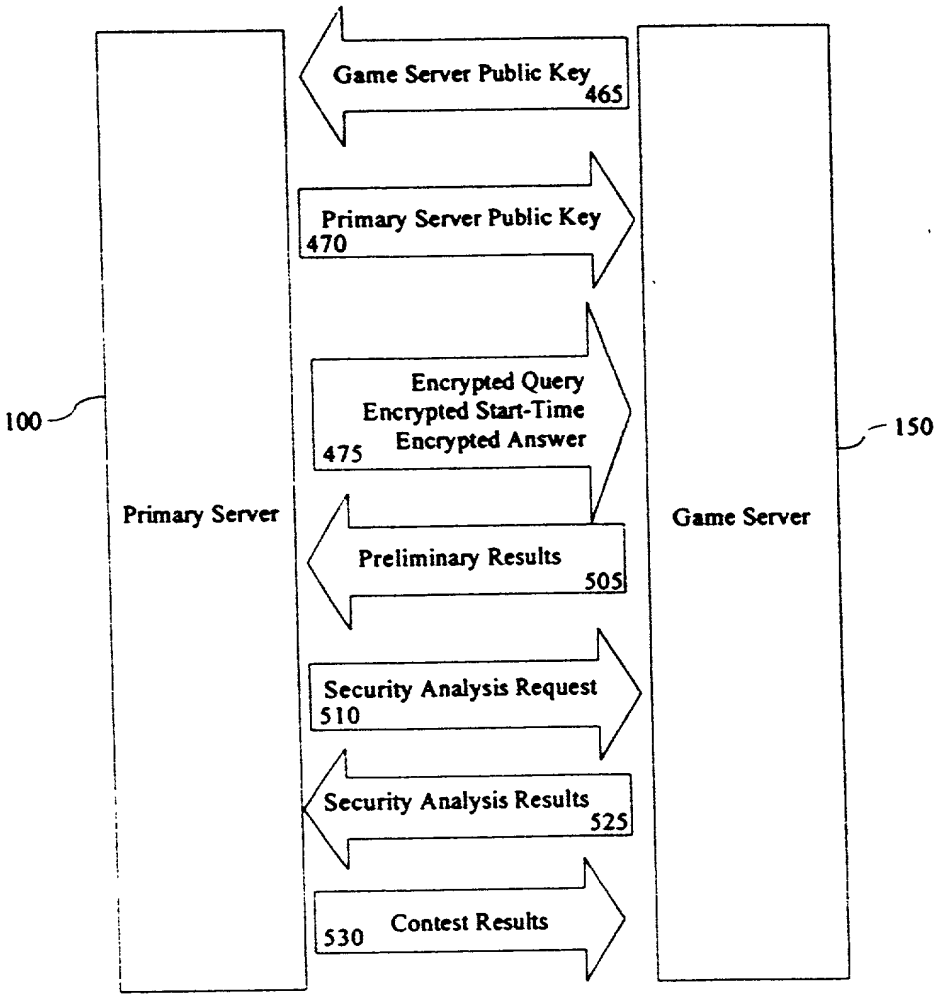

Game Server Public Key
465
Primary Server Public Key
470
Encrypted Query
Encrypted Start-Time
Encrypted Answer
475
100
150
Primary Server
Game Server
Preliminary Results
505
Security Analysis Request
510
Security Analysis Results
525
Contest Results
530

Figure 3F

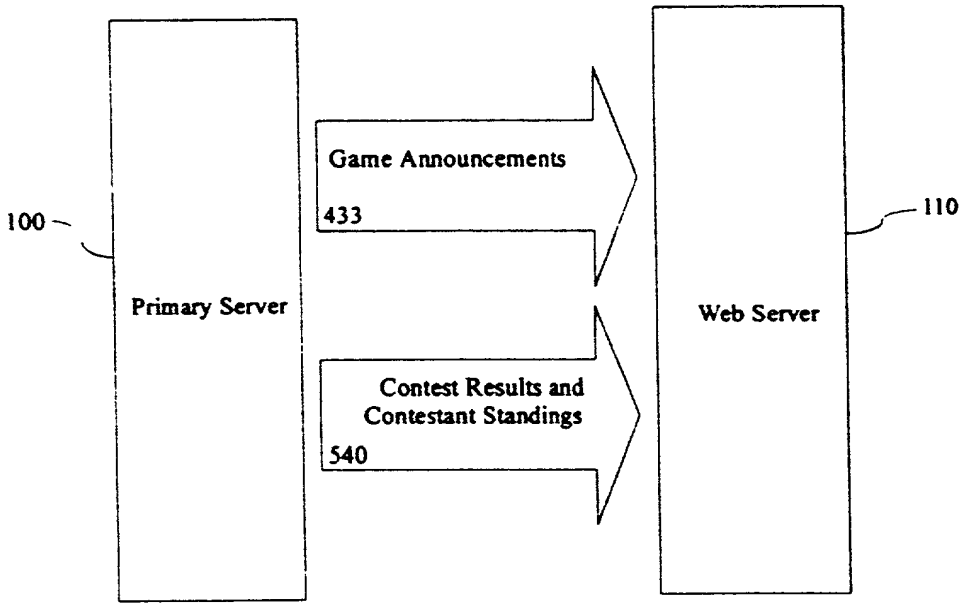

100
Primary Server
Game Announcements
433
Contest Results and
Contestant Standings
540
Web Server
110

Figure 3G

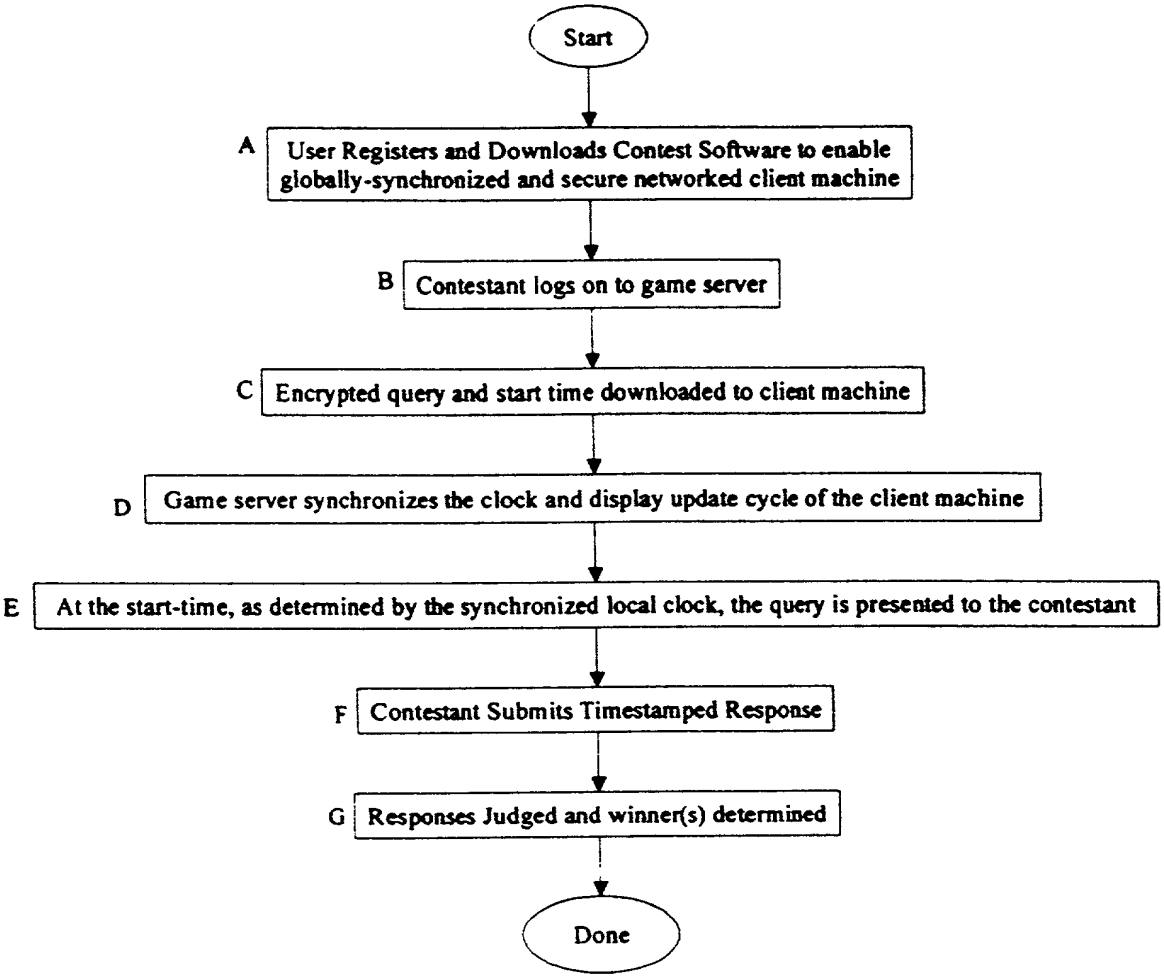


Figure 4

SUBSTITUTE SHEET (RULE 26)

User Registers and Downloads Contest Software

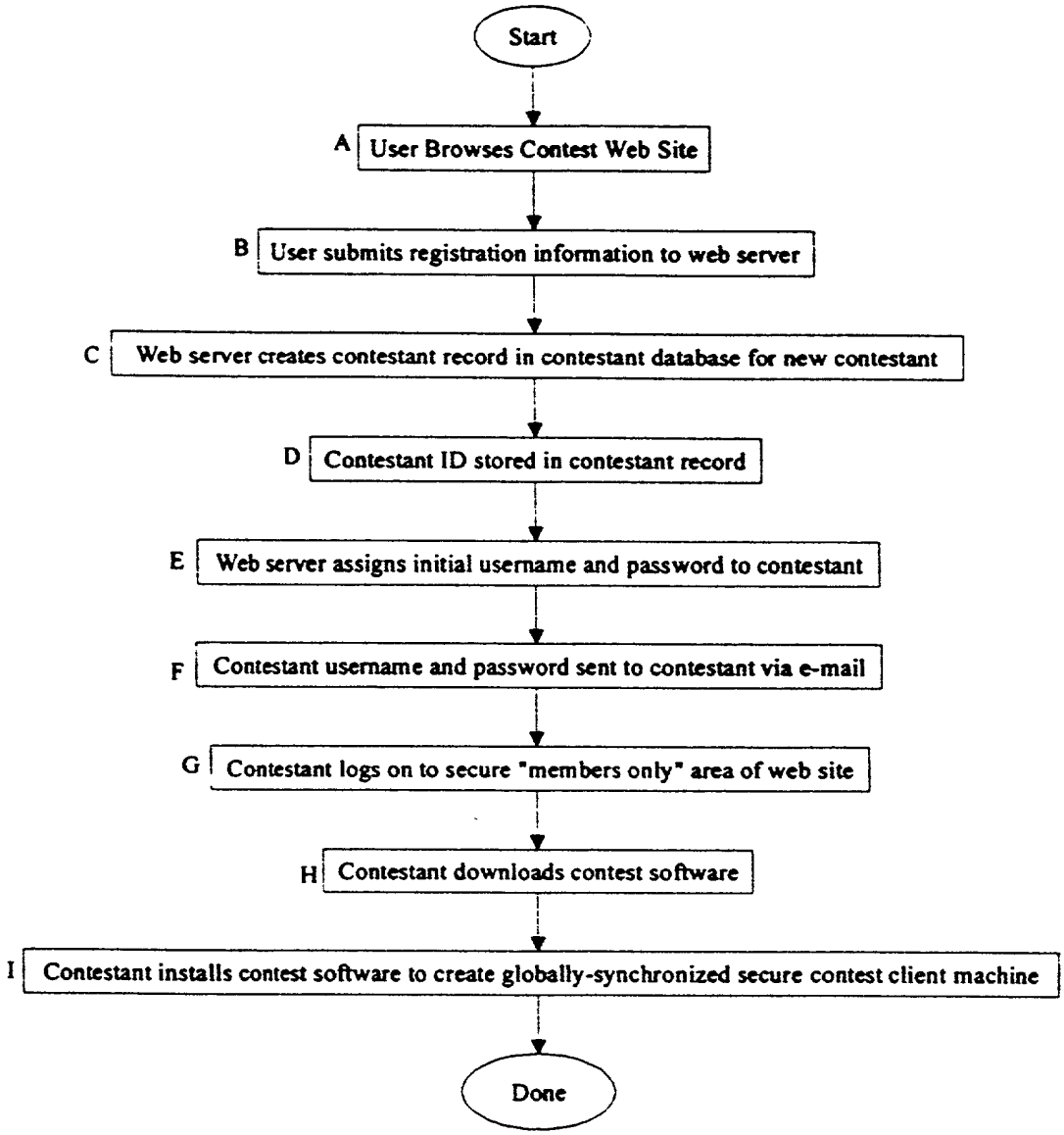


Figure 4A

Contestant logs on to game server

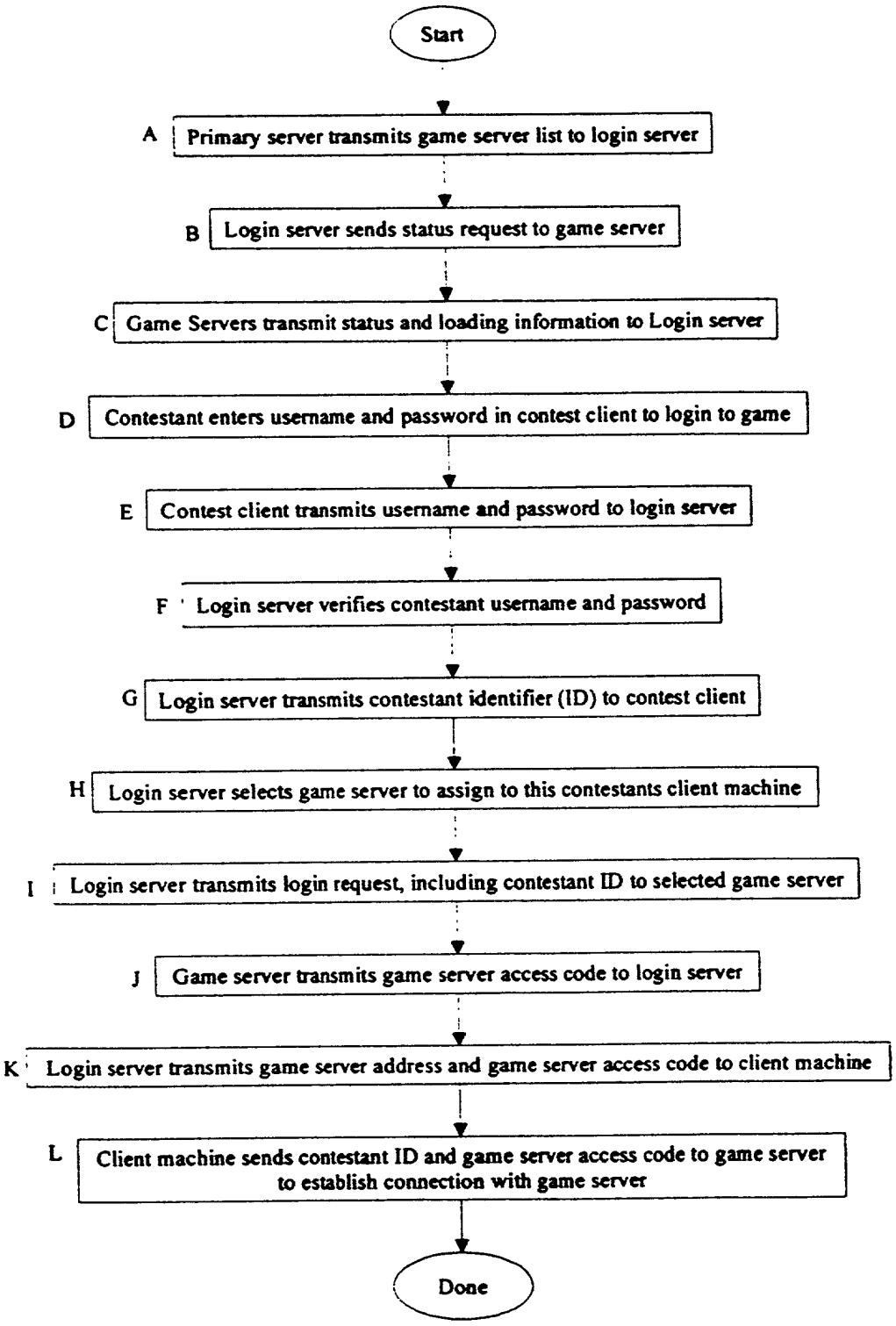


Figure 4B

Encrypted query and start-time downloaded to client machine

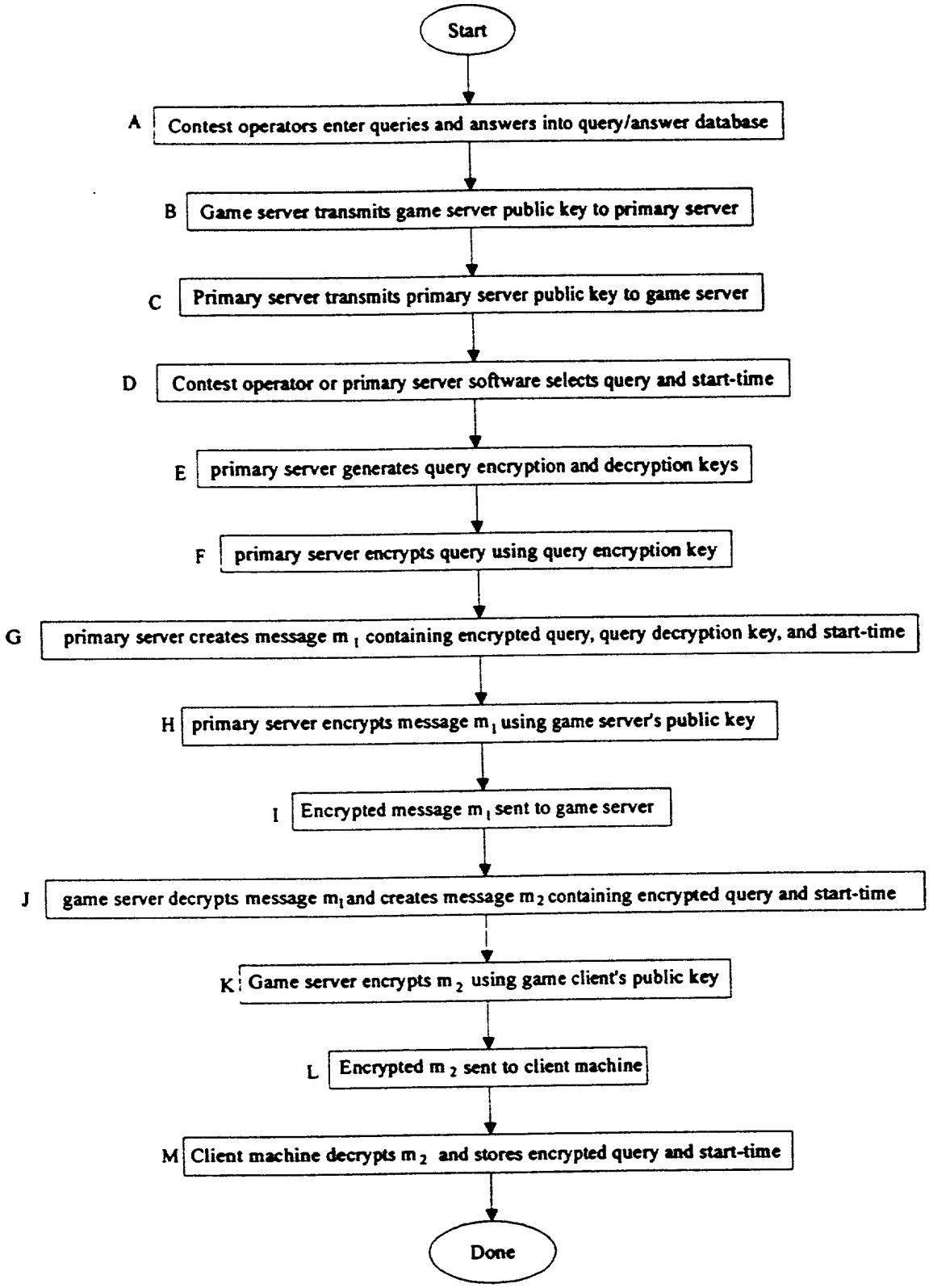


Figure 4C

Client machine clock characterized and display update cycle synchronized with global clock

(Client Machine With Basic GSU)

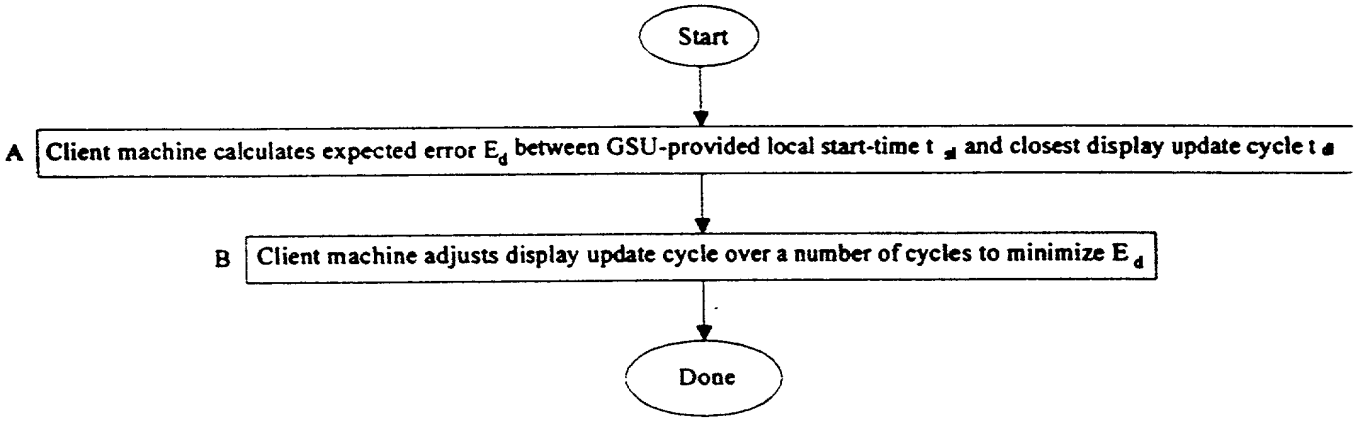


Figure 4D1

Client machine clock characterized and display update cycle synchronized with global clock

(Client Machine With Enhanced GSU)

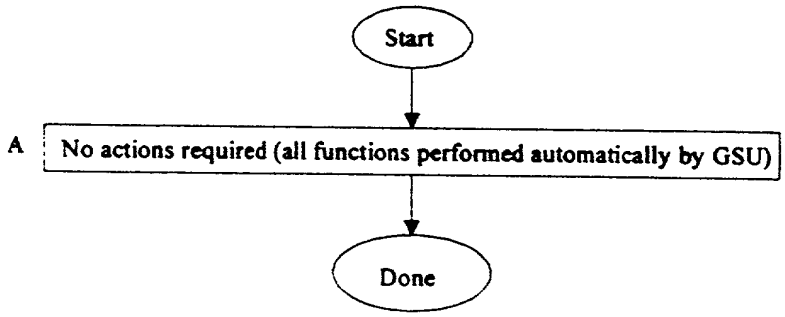


Figure 4D2

SUBSTITUTE SHEET (RULE 26)

Client machine clock characterized and display update cycle synchronized with global clock

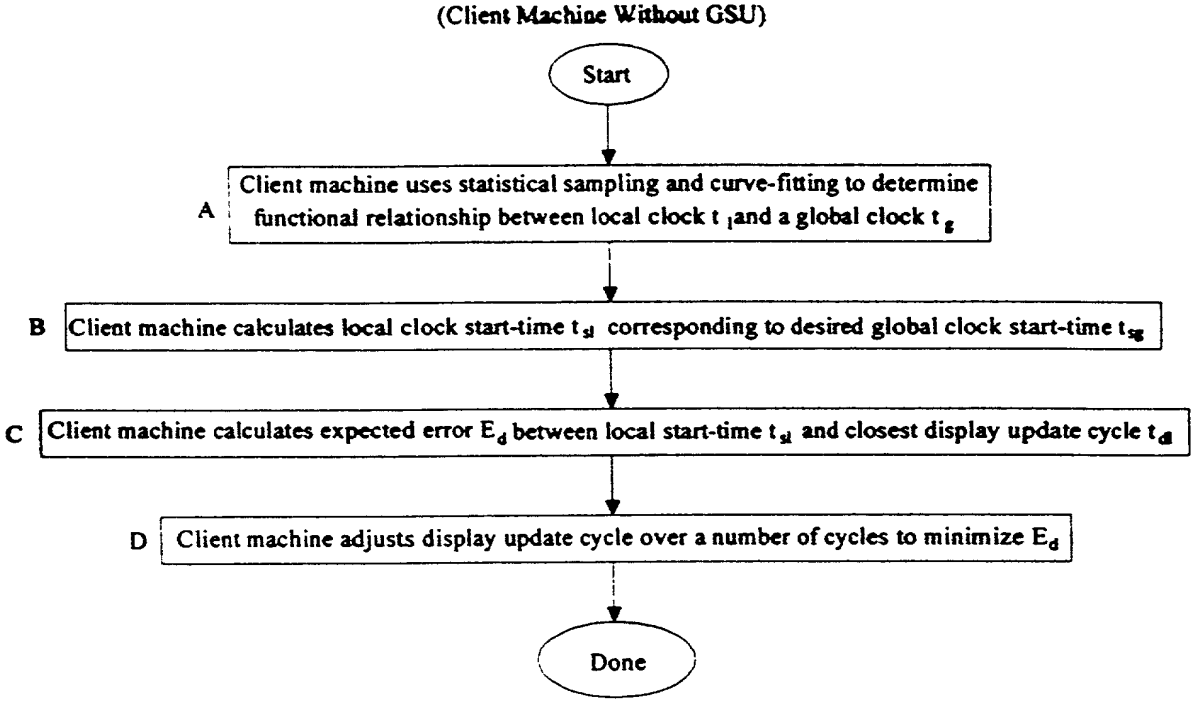


Figure 4D3

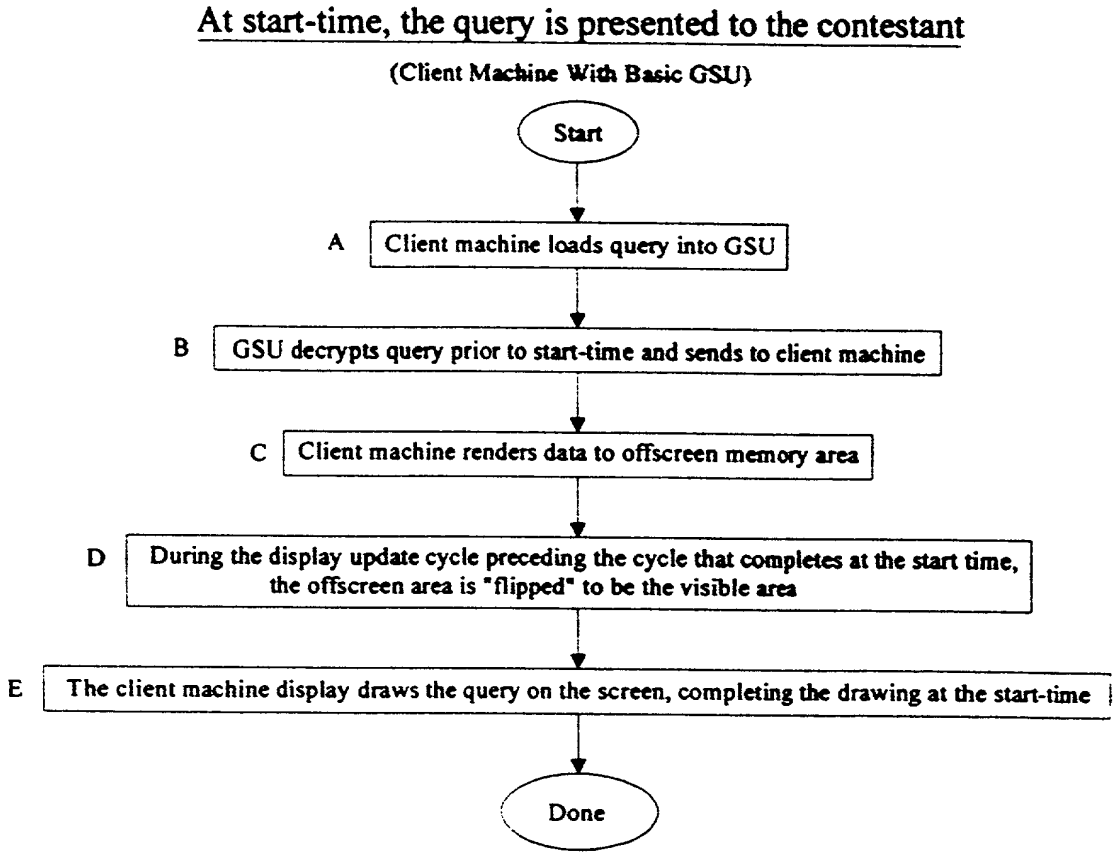

At start-time, the query is presented to the contestant
(Client Machine With Basic GSU)
Start
A
Client machine loads query into GSU
B
GSU decrypts query prior to start-time and sends to client machine
C
Client machine renders data to offscreen memory area
D
During the display update cycle preceding the cycle that completes at the start time, the offscreen area is "flipped" to be the visible area
E
The client machine display draws the query on the screen, completing the drawing at the start-time
Done

Figure 4E1

At start-time, the query is presented to the contestant

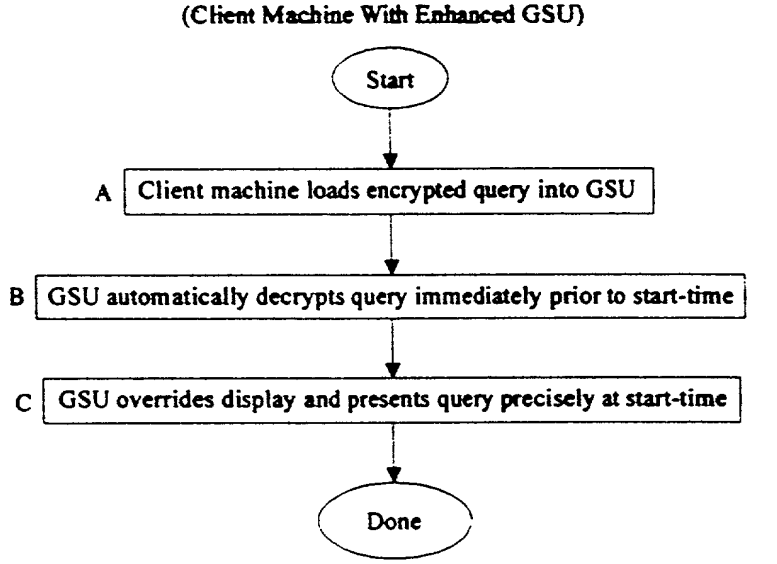


Figure 4E2

Document = 20070300

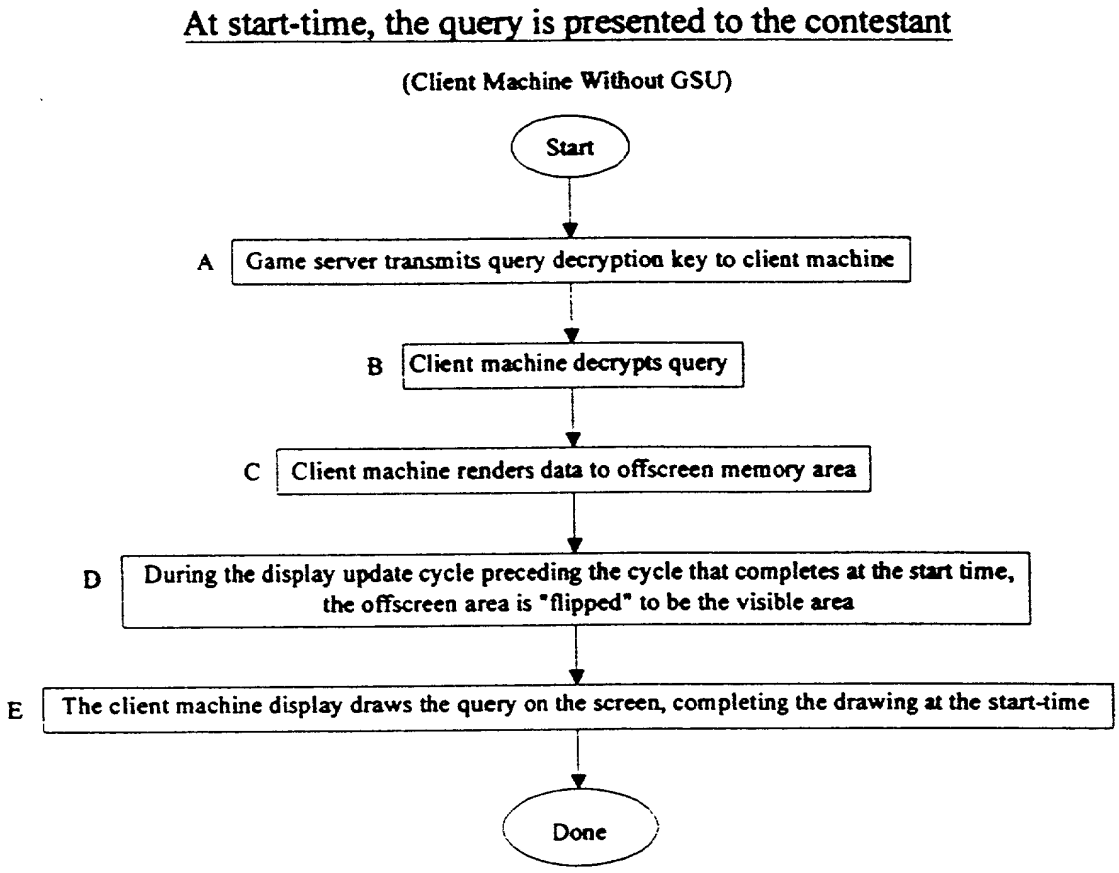

At start-time, the query is presented to the contestant
(Client Machine Without GSU)
Start
A
Game server transmits query decryption key to client machine
B
Client machine decrypts query
C
Client machine renders data to offscreen memory area
D
During the display update cycle preceding the cycle that completes at the start time, the offscreen area is "flipped" to be the visible area
E
The client machine display draws the query on the screen, completing the drawing at the start-time
Done

Figure 4E3

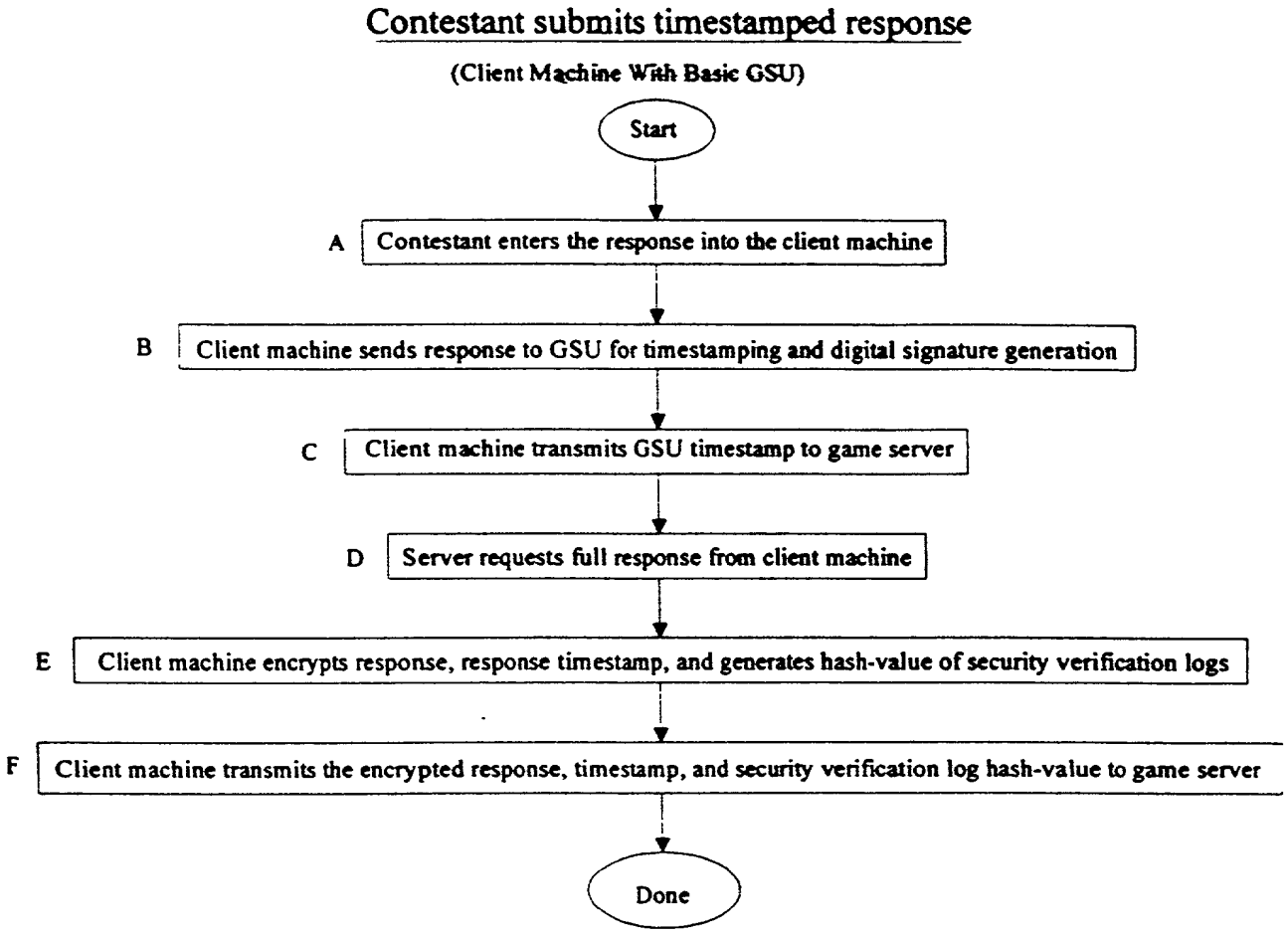

Contestant submits timestamped response
(Client Machine With Basic GSU)
Start
A
Contestant enters the response into the client machine
B
Client machine sends response to GSU for timestamping and digital signature generation
C
Client machine transmits GSU timestamp to game server
D
Server requests full response from client machine
E
Client machine encrypts response, response timestamp, and generates hash-value of security verification logs
F
Client machine transmits the encrypted response, timestamp, and security verification log hash-value to game server
Done

Figure 4F1

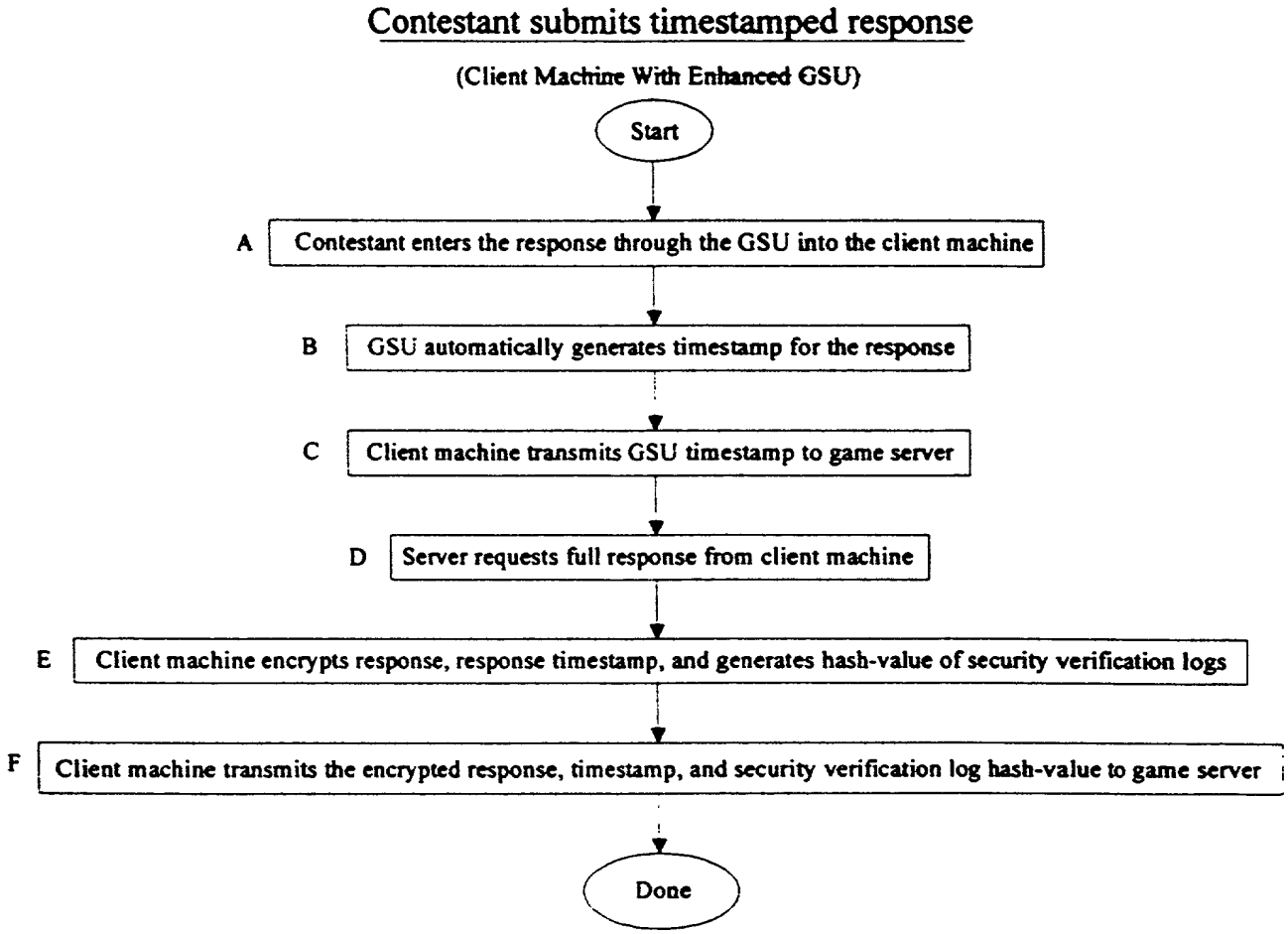

Contestant submits timestamped response
(Client Machine With Enhanced GSU)
Start
A
Contestant enters the response through the GSU into the client machine
B
GSU automatically generates timestamp for the response
C
Client machine transmits GSU timestamp to game server
D
Server requests full response from client machine
E
Client machine encrypts response, response timestamp, and generates hash-value of security verification logs
F
Client machine transmits the encrypted response, timestamp, and security verification log hash-value to game server
Done

Figure 4F2

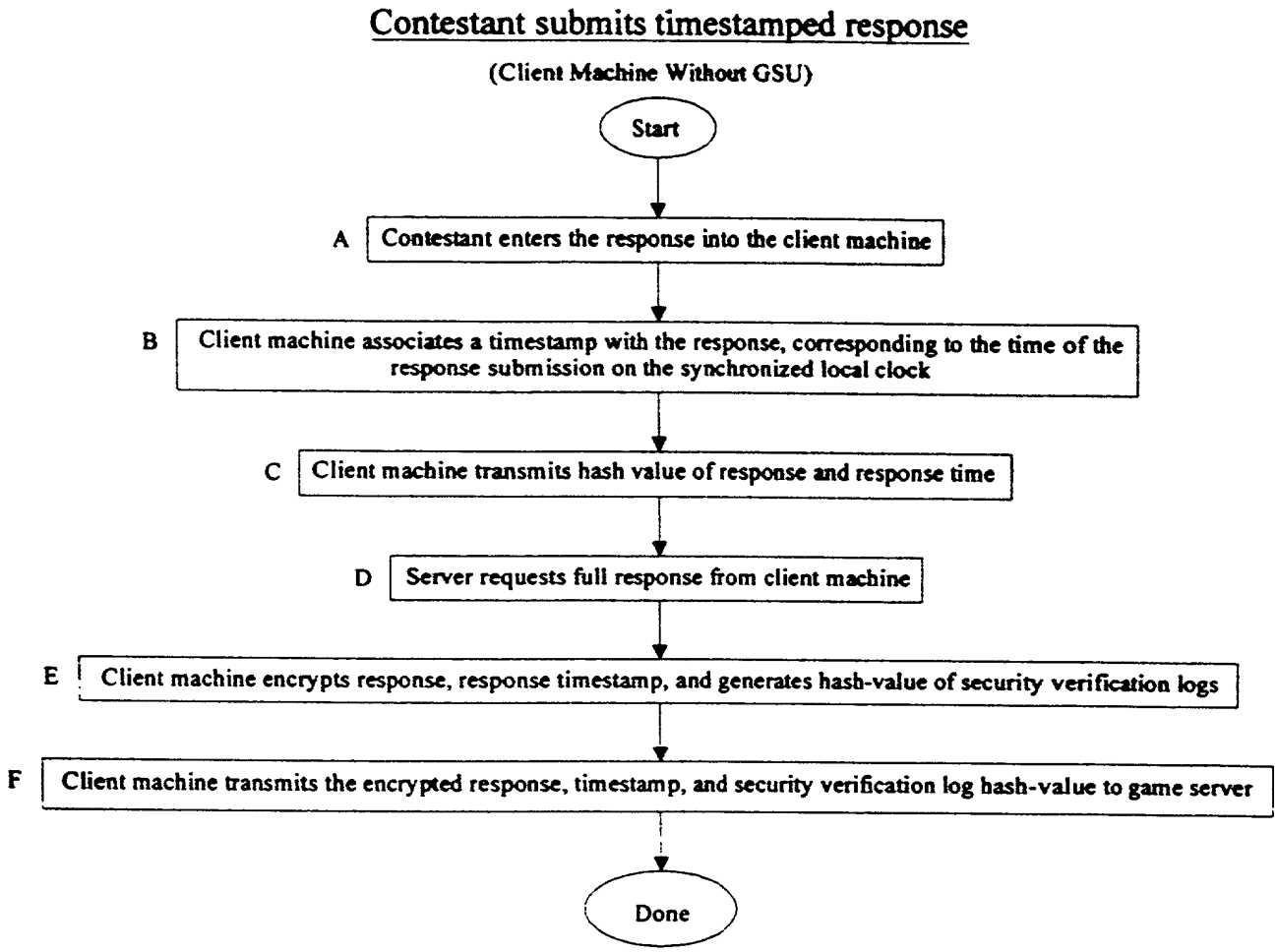

Contestant submits timestamped response
(Client Machine Without GSU)
Start
A
Contestant enters the response into the client machine
B
Client machine associates a timestamp with the response, corresponding to the time of the response submission on the synchronized local clock
C
Client machine transmits hash value of response and response time
D
Server requests full response from client machine
E
Client machine encrypts response, response timestamp, and generates hash-value of security verification logs
F
Client machine transmits the encrypted response, timestamp, and security verification log hash-value to game server
Done

Figure 4F3

Responses Judged and Winners Determined

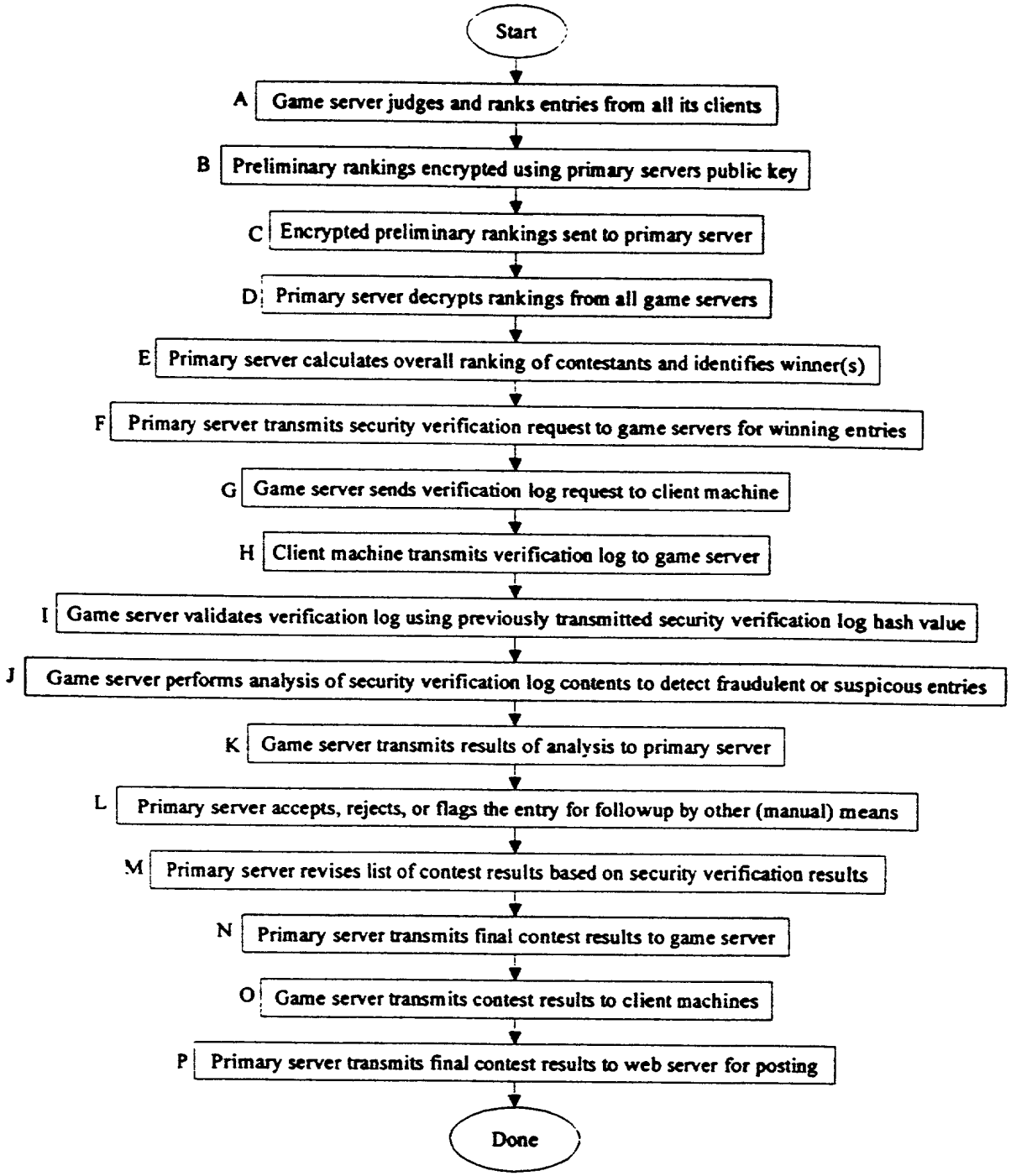


Figure 4G

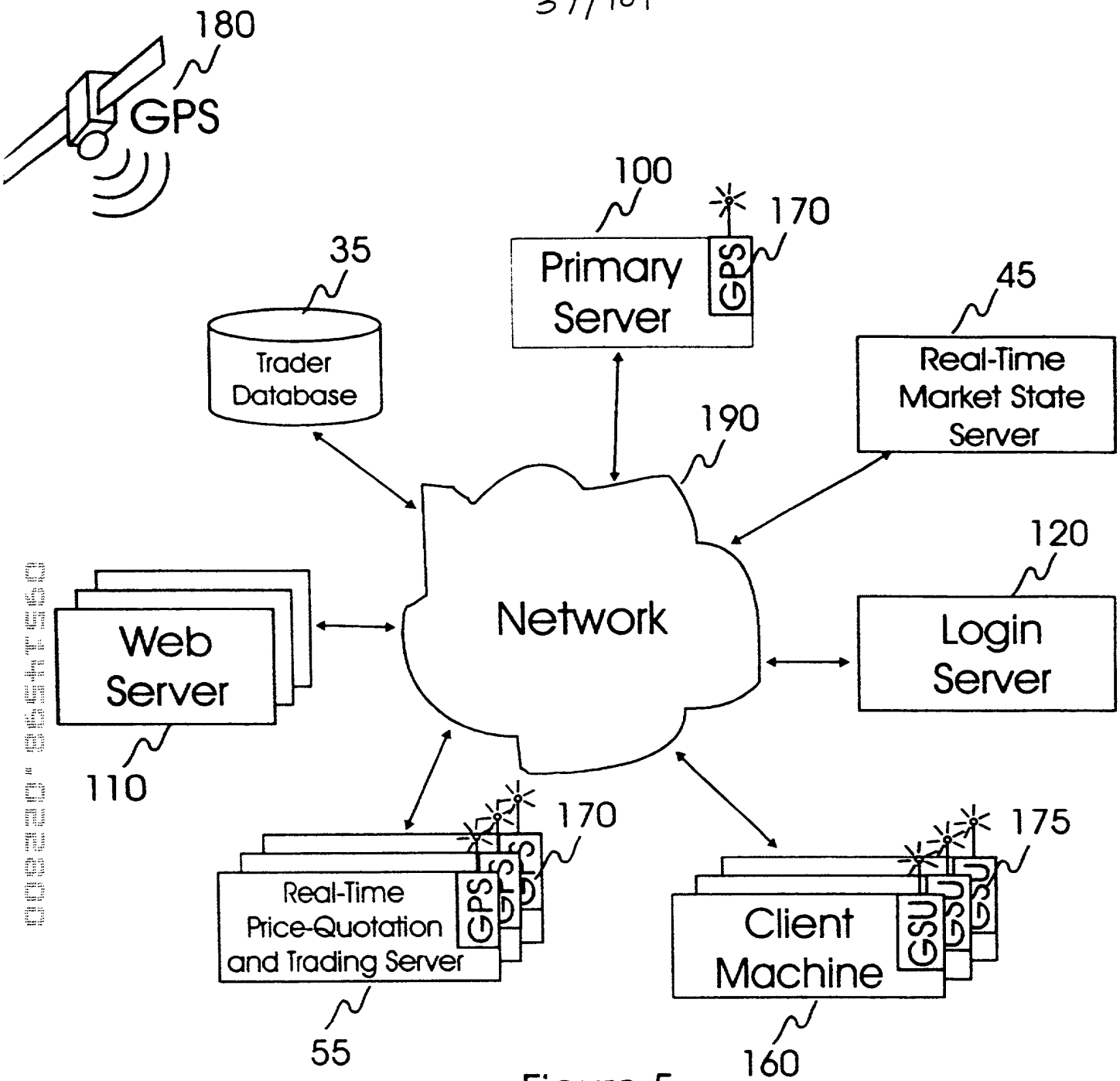

180
GPS
100
170
Primary Server
GPS
35
Trader Database
45
Real-Time Market State Server
190
Network
120
Login Server
Web Server
110
170
Real-Time Price-Quotation and Trading Server
GPS
55
175
Client Machine
GSU
160

Figure 5

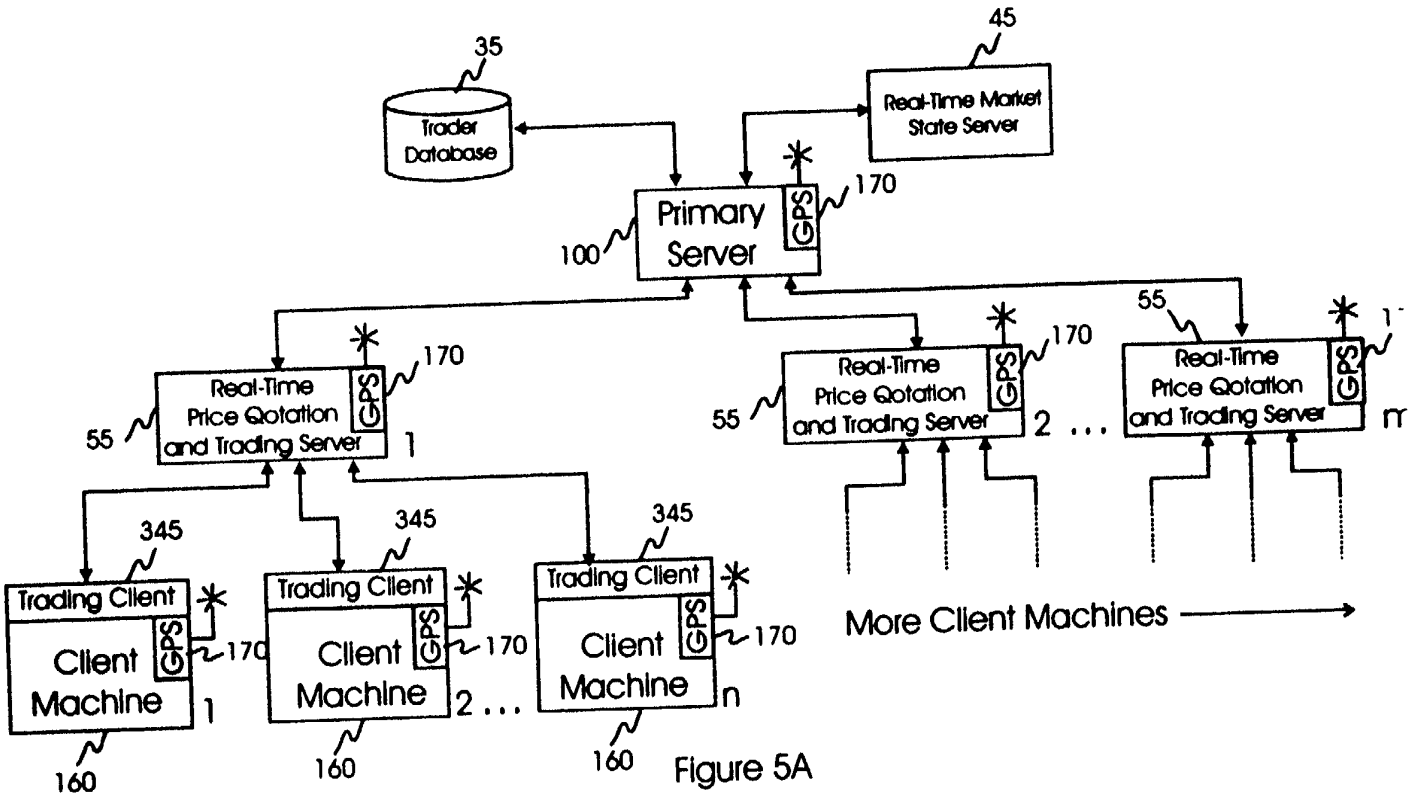

35
Trader Database
45
Real-Time Market State Server
100
Primary Server
GPS
170
55
Real-Time Price Qotation and Trading Server
1
2 ...
m
More Client Machines
345
Trading Client
Client Machine
160

Figure 5A

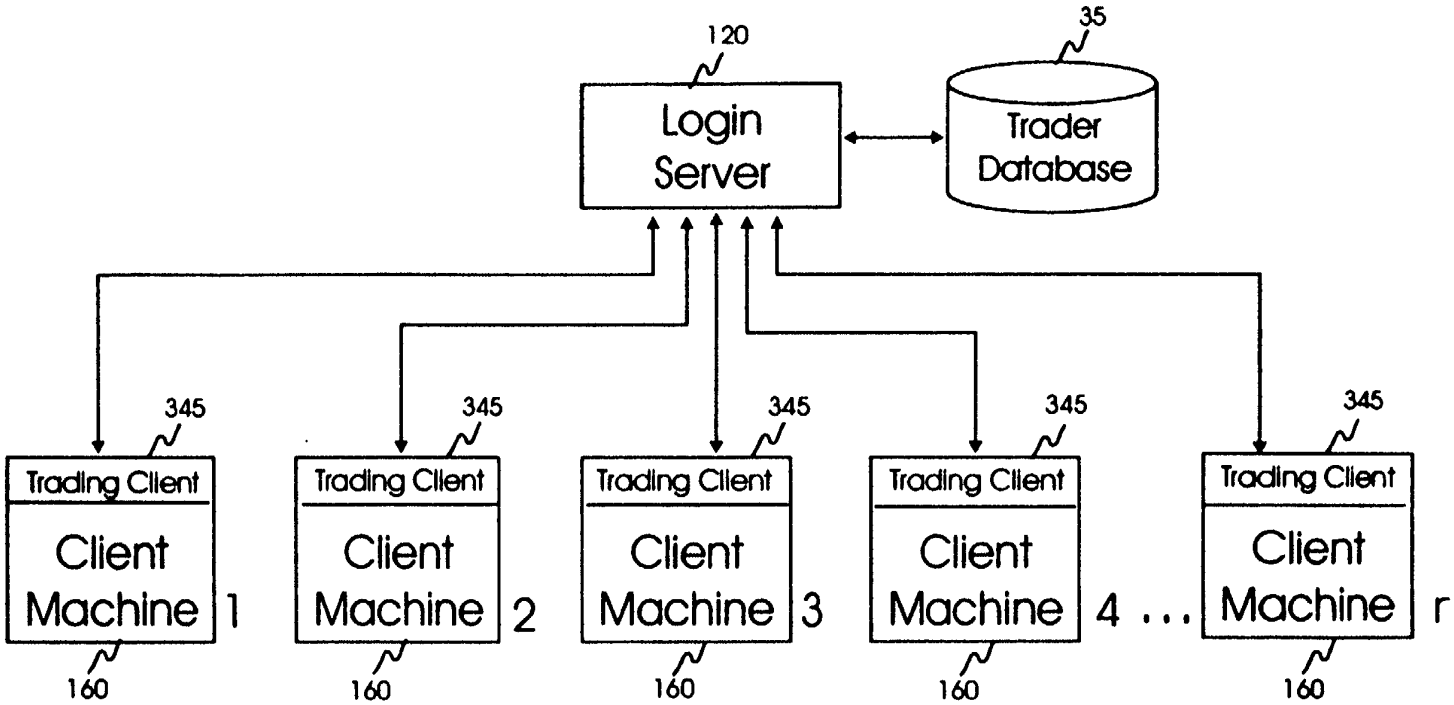

120
Login Server
35
Trader Database
345
Trading Client
Client Machine 1
Client Machine 2
Client Machine 3
Client Machine 4 ...
Client Machine r
160

Figure 5B

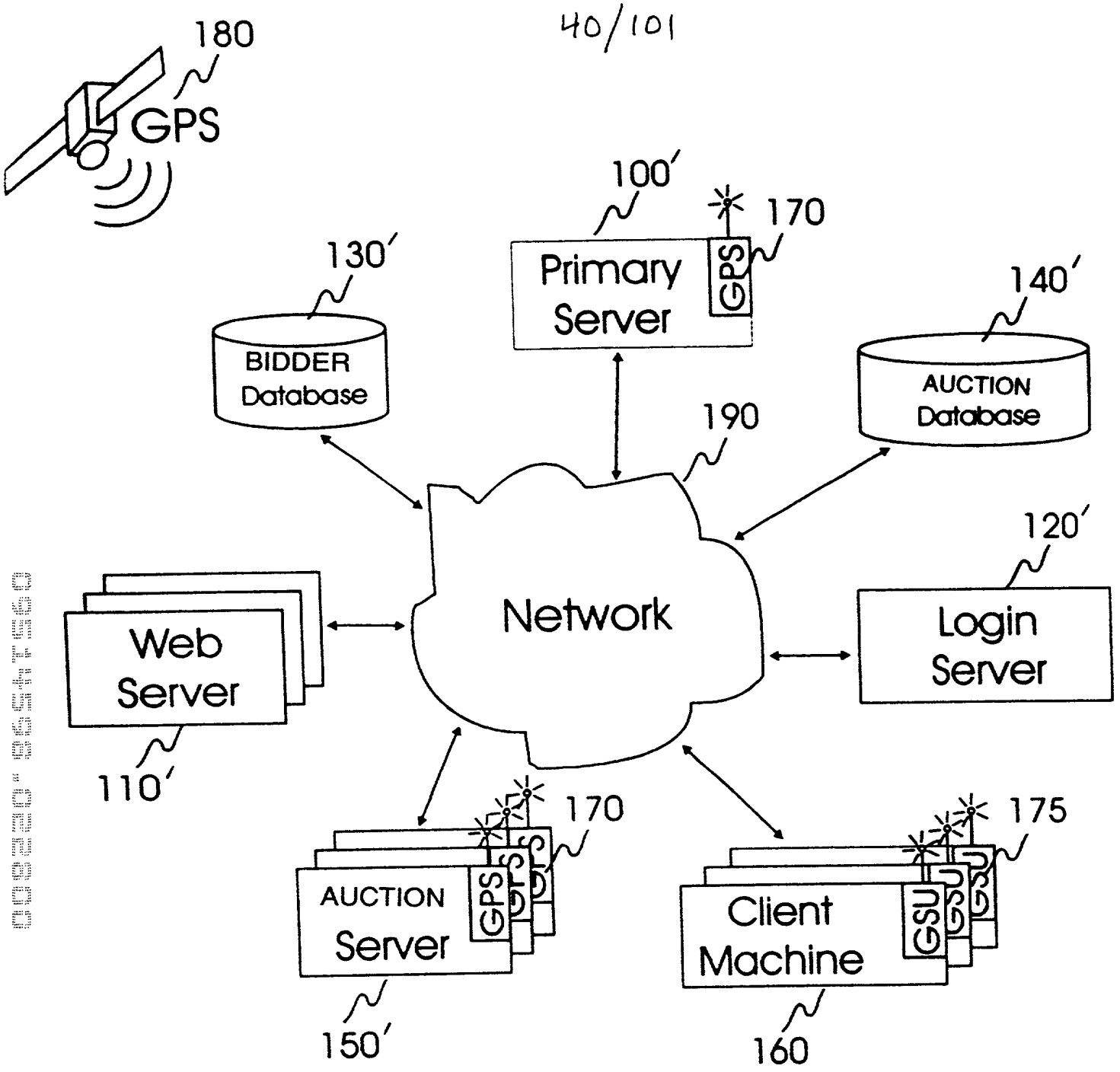

180
GPS
100'
Primary Server
GPS
170
130'
BIDDER Database
140'
AUCTION Database
190
Network
120'
Login Server
Web Server
110'
AUCTION Server
GPS
170
150'
Client Machine
GSU
175
160

FIG. 6

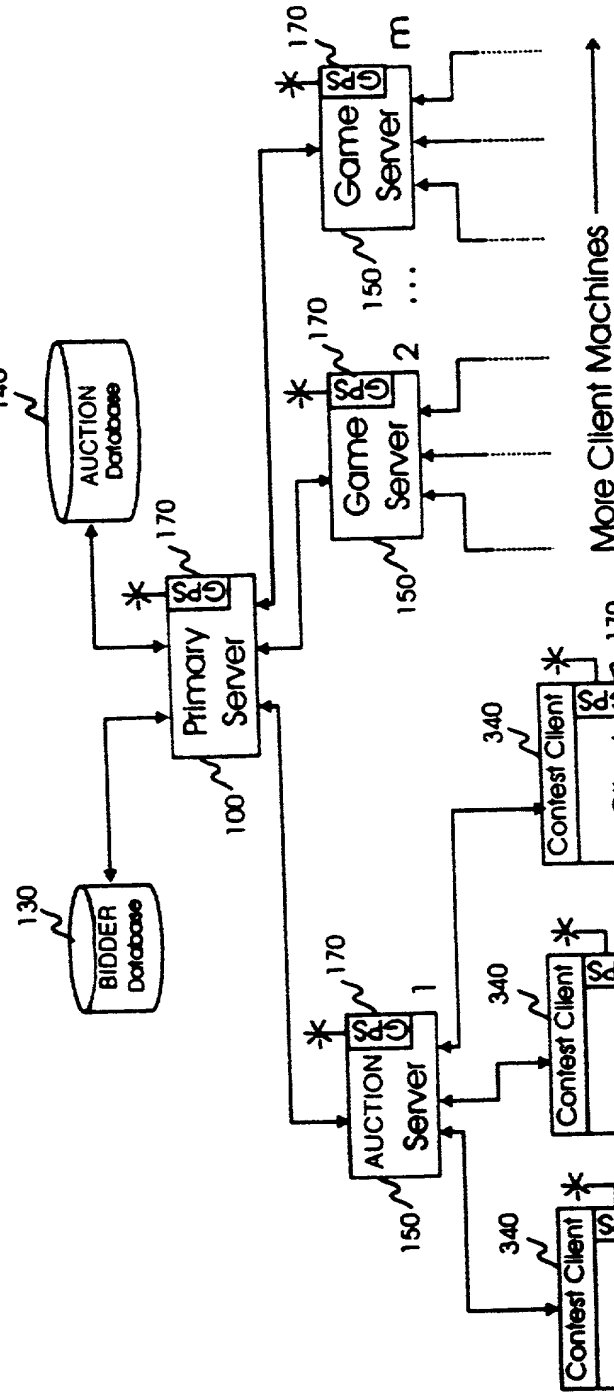

130
BIDDER Database
140
AUCTION Database
100
Primary Server
170
150
AUCTION Server
1
150
Game Server
2
150
Game Server
m
340
Contest Client
Client Machine
160
1
2 ...
n
More Client Machines

FIG. 6A

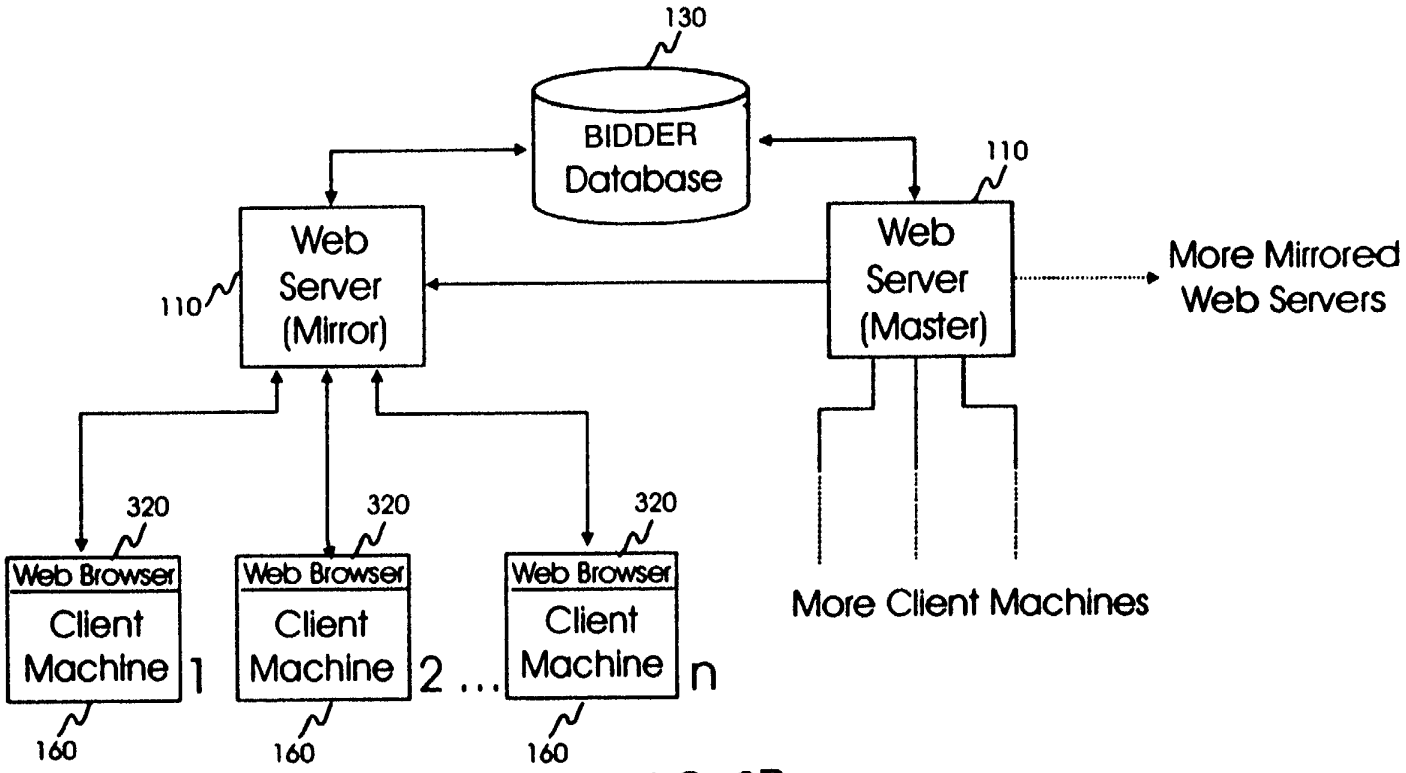

130
BIDDER
Database
110
Web
Server
(Mirror)
110
Web
Server
(Master)
More Mirrored
Web Servers
320
320
320
Web Browser
Client
Machine
1
Web Browser
Client
Machine
2 ...
Web Browser
Client
Machine
n
160
160
160
More Client Machines

FIG. 6B

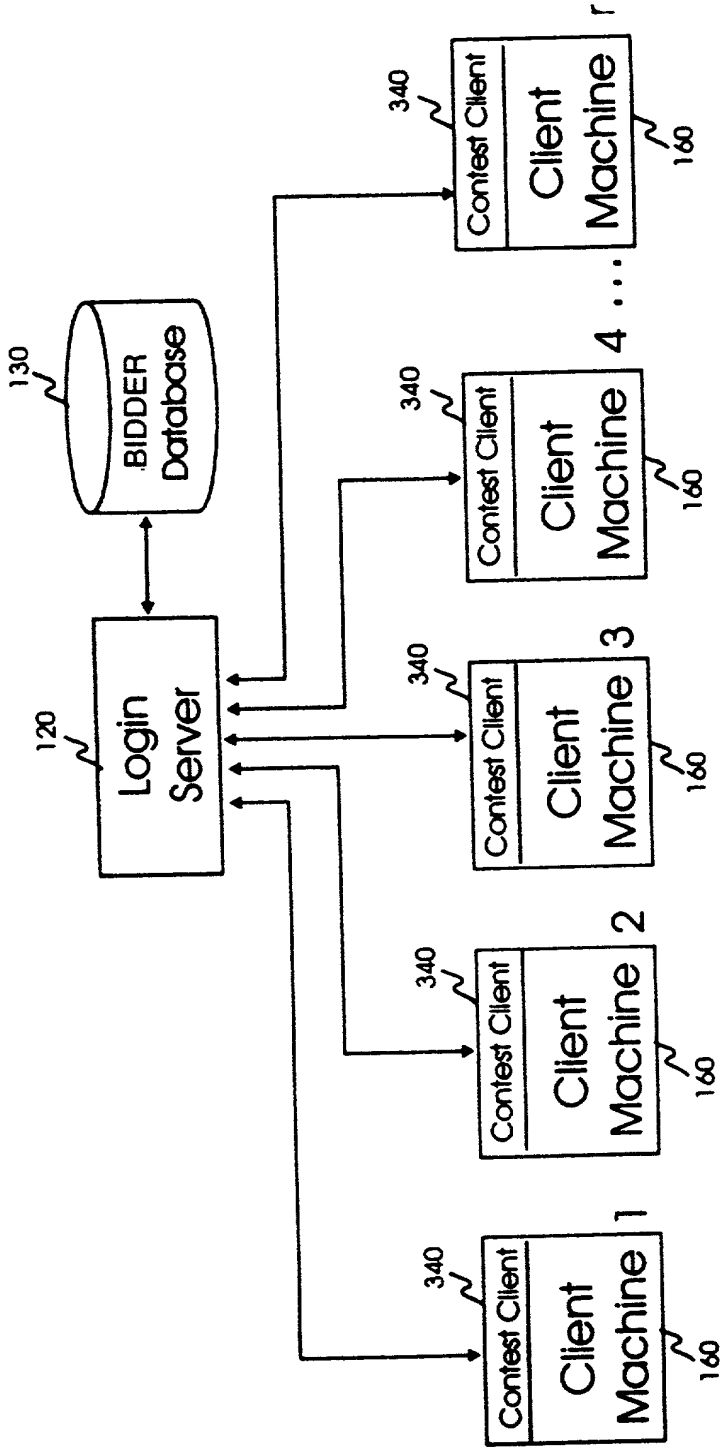

130
BIDDER Database
120
Login Server
340
Contest Client
Client Machine
160
1
2
3
4 . . . r

FIG. 6C

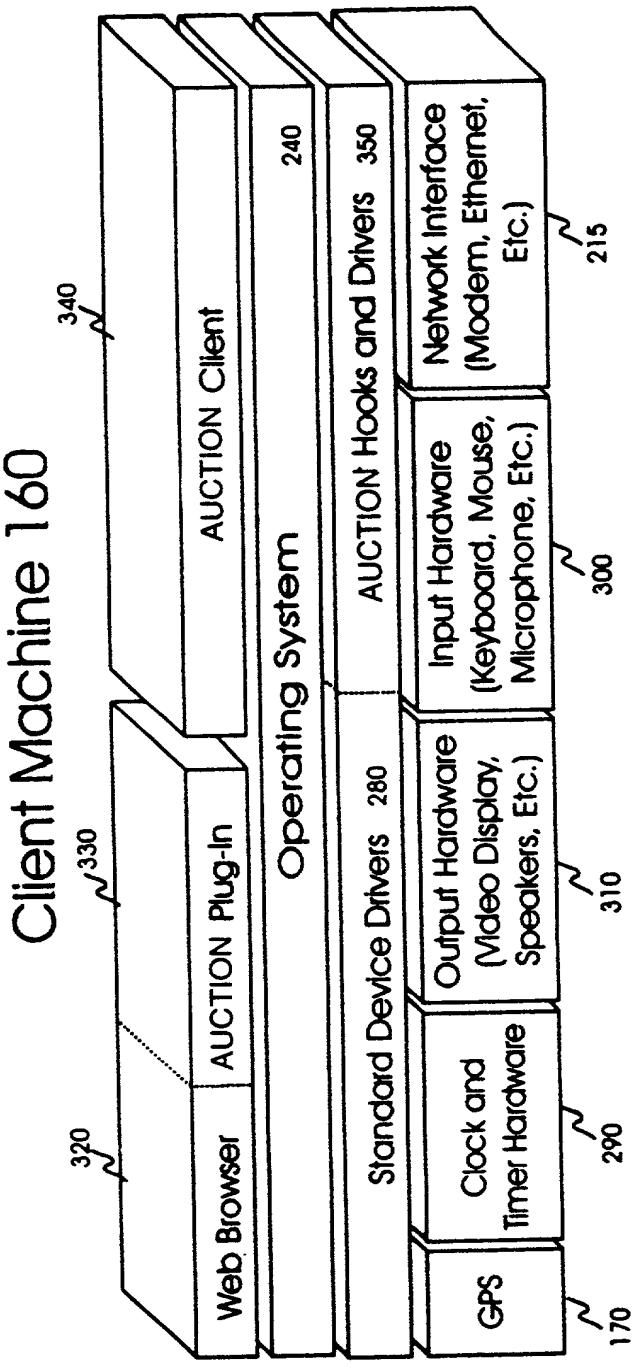

Client Machine 160
320
330
340
Web Browser
AUCTION Plug-In
AUCTION Client
Operating System
240
Standard Device Drivers 280
AUCTION Hooks and Drivers 350
GPS
Clock and Timer Hardware
Output Hardware (Video Display, Speakers, Etc.)
Input Hardware (Keyboard, Mouse, Microphone, Etc.)
Network Interface (Modem, Ethernet, Etc.)
170
290
310
300
215

FIG. 6D

09930 "SEARCH

AUCTION SERVER 150'

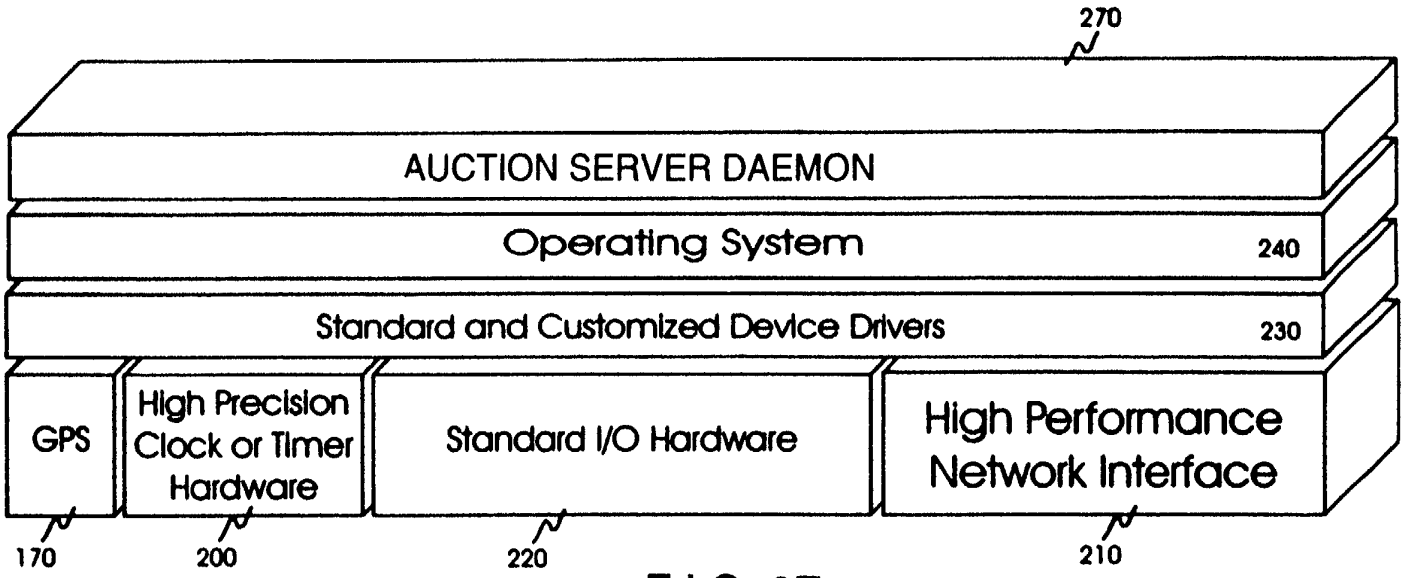


FIG. 6E

09/320,864

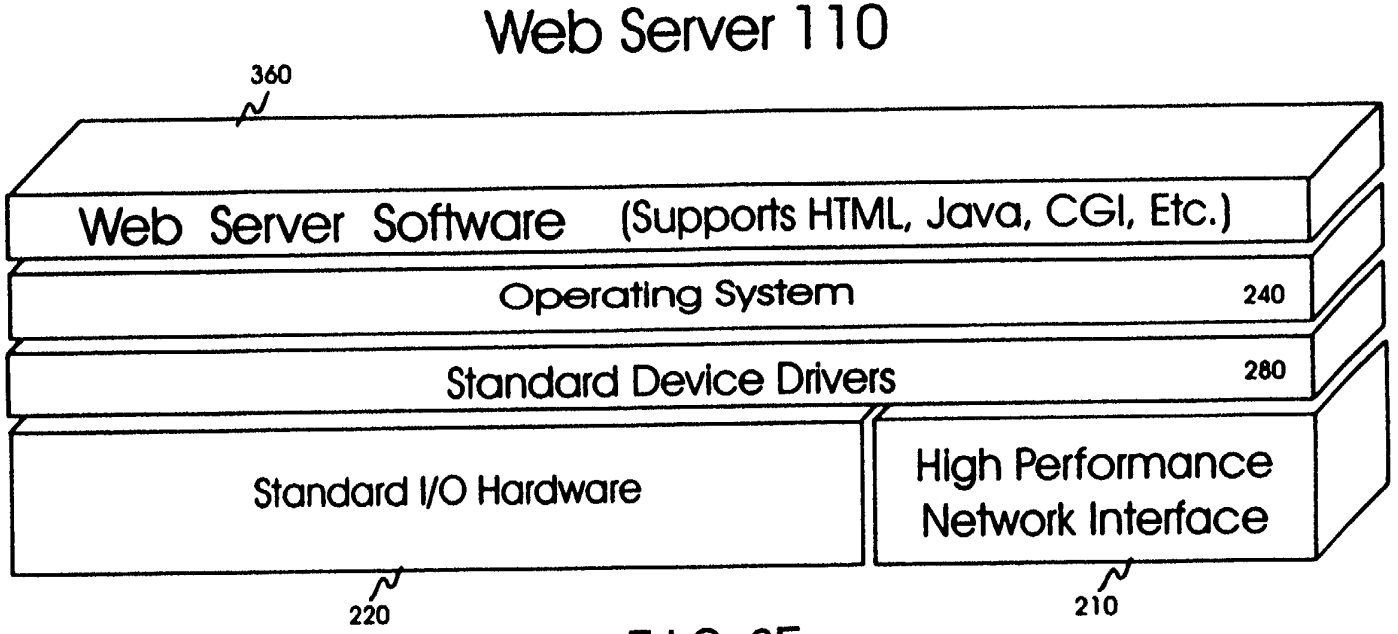


FIG. 6F

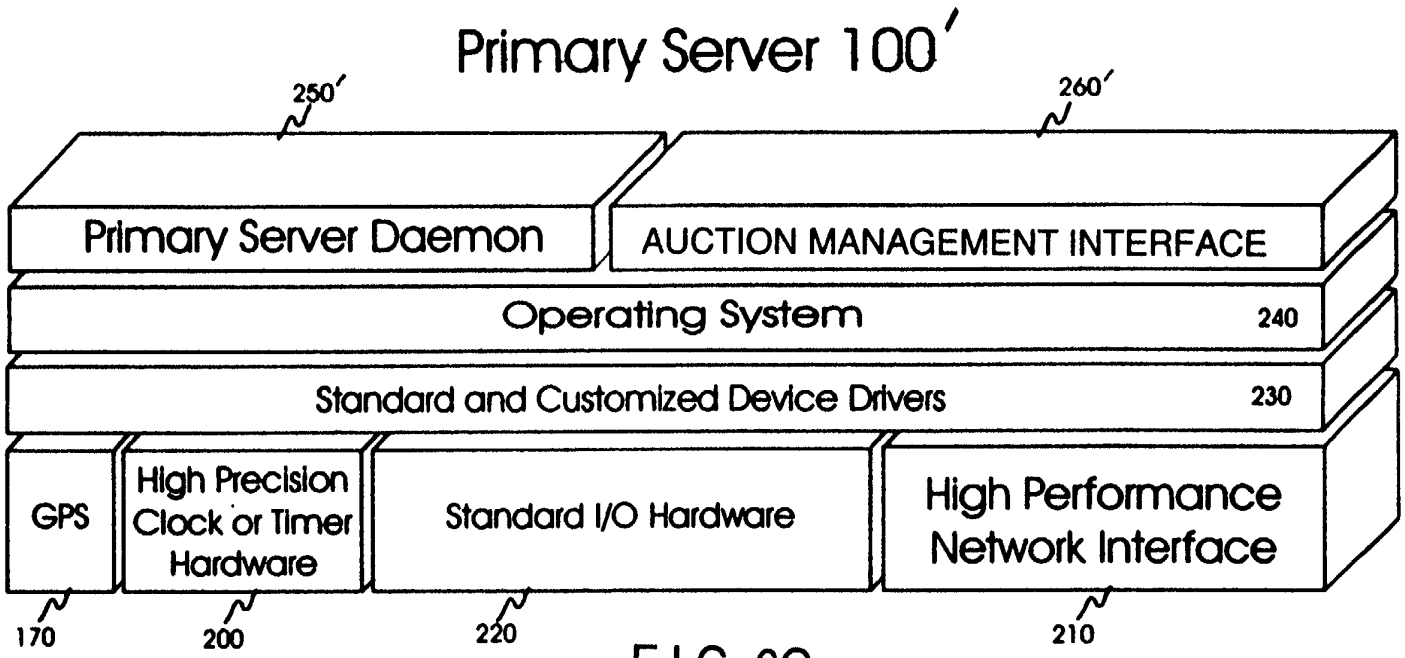

Primary Server 100'
250'
260'
Primary Server Daemon
AUCTION MANAGEMENT INTERFACE
Operating System
240
Standard and Customized Device Drivers
230
GPS
High Precision Clock or Timer Hardware
Standard I/O Hardware
High Performance Network Interface
170
200
220
210

FIG. 6G

09830 "9654T650

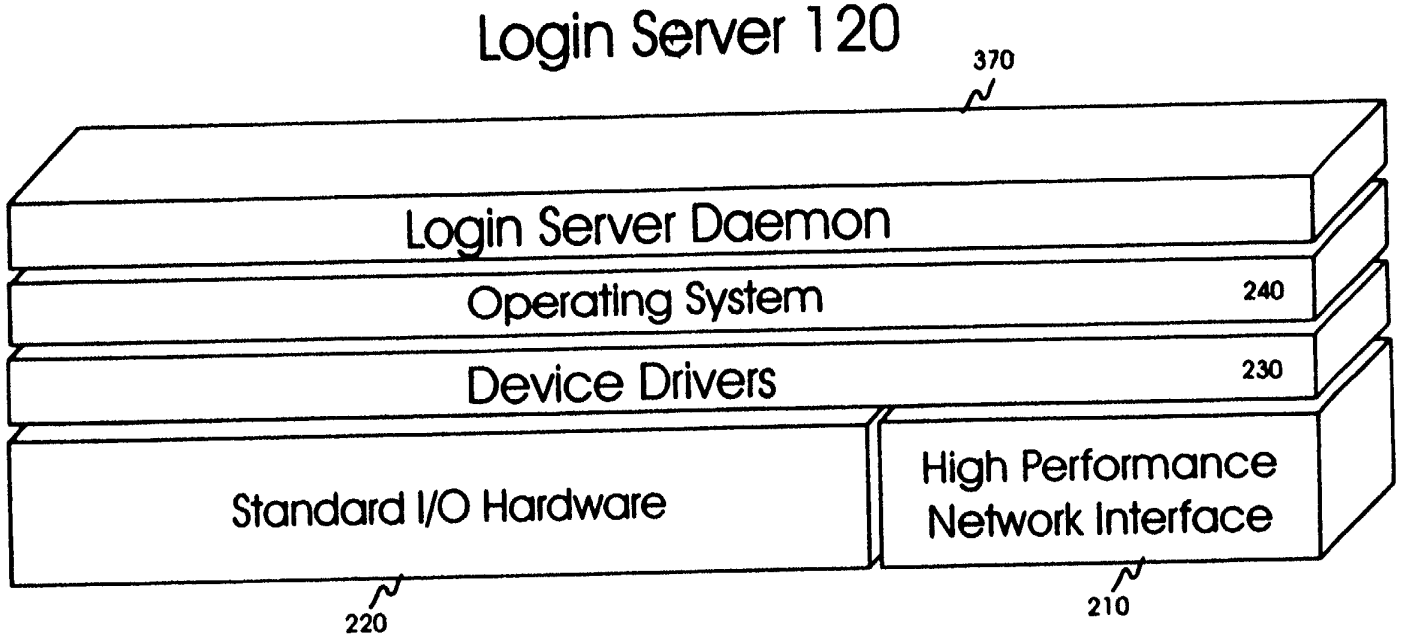


FIG. 6H

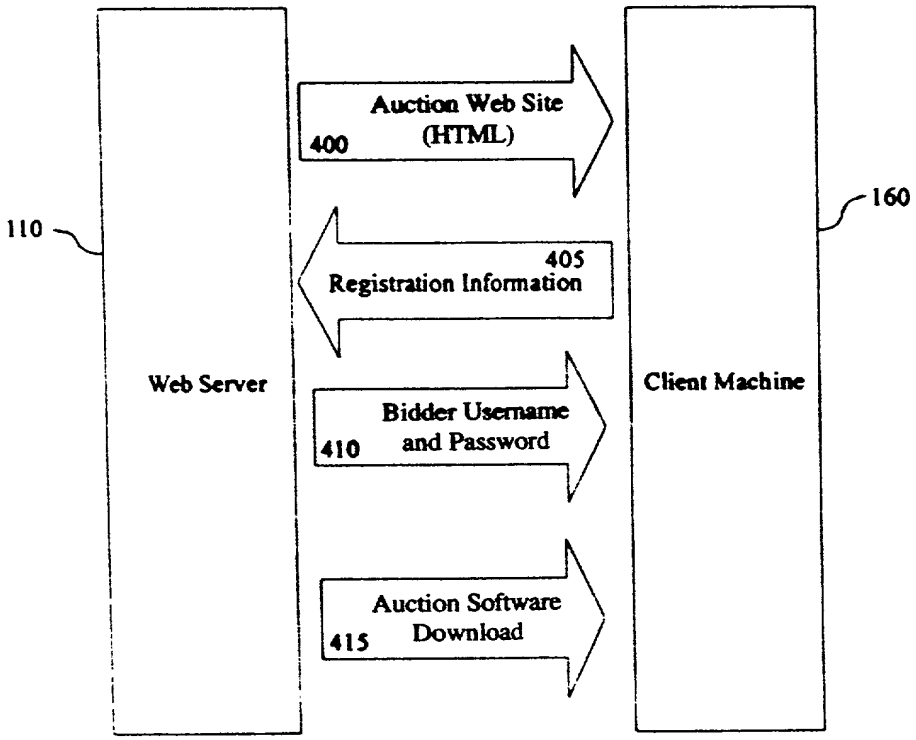

110
Web Server
Auction Web Site
400 (HTML)
405
Registration Information
Bidder Username
410 and Password
Auction Software
415 Download
Client Machine
160

FIG. 7A

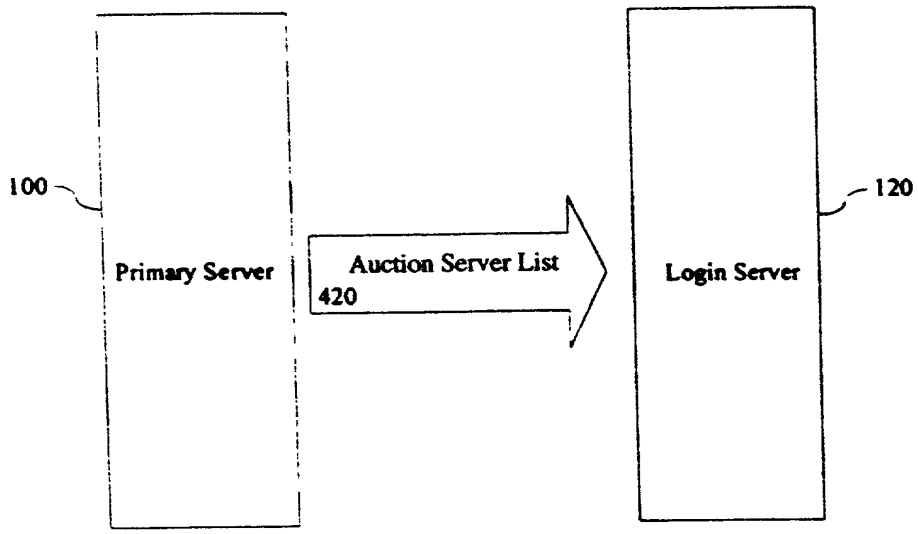


FIG. 7B

Docket No. 50277-2000

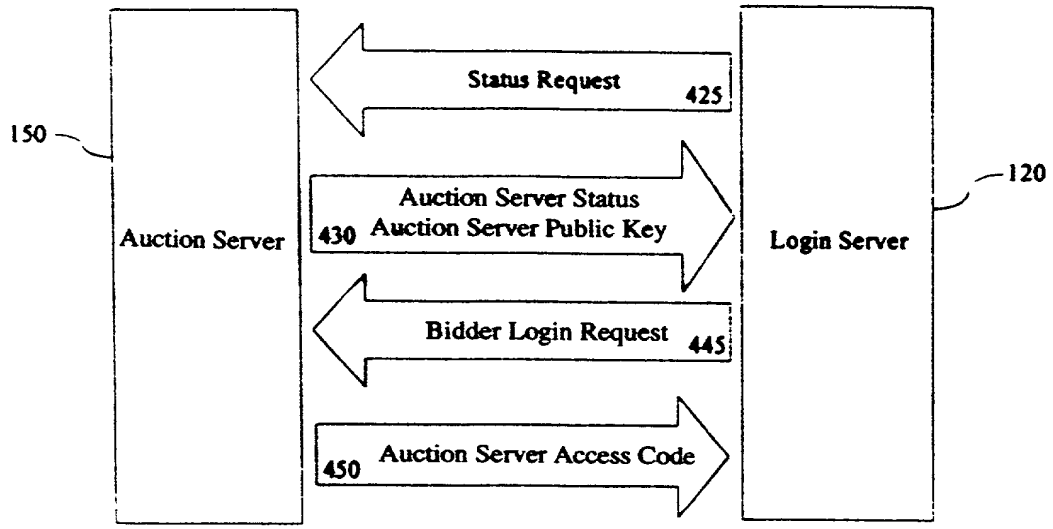

150
Auction Server
Status Request
425
Auction Server Status
430 Auction Server Public Key
Bidder Login Request
445
450 Auction Server Access Code
Login Server
120

FIG. 7C

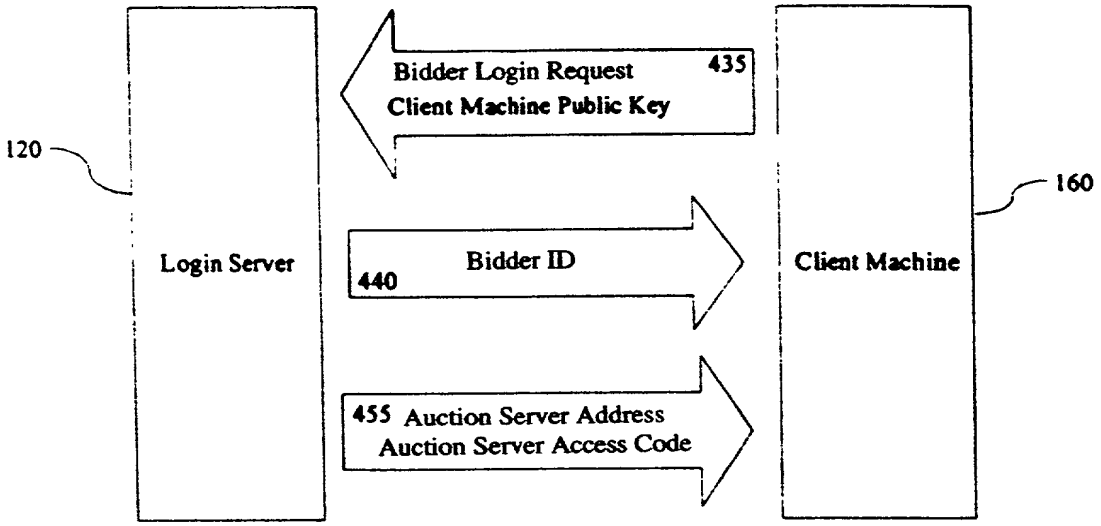


FIG. 7D

Docket No. 50277-0001

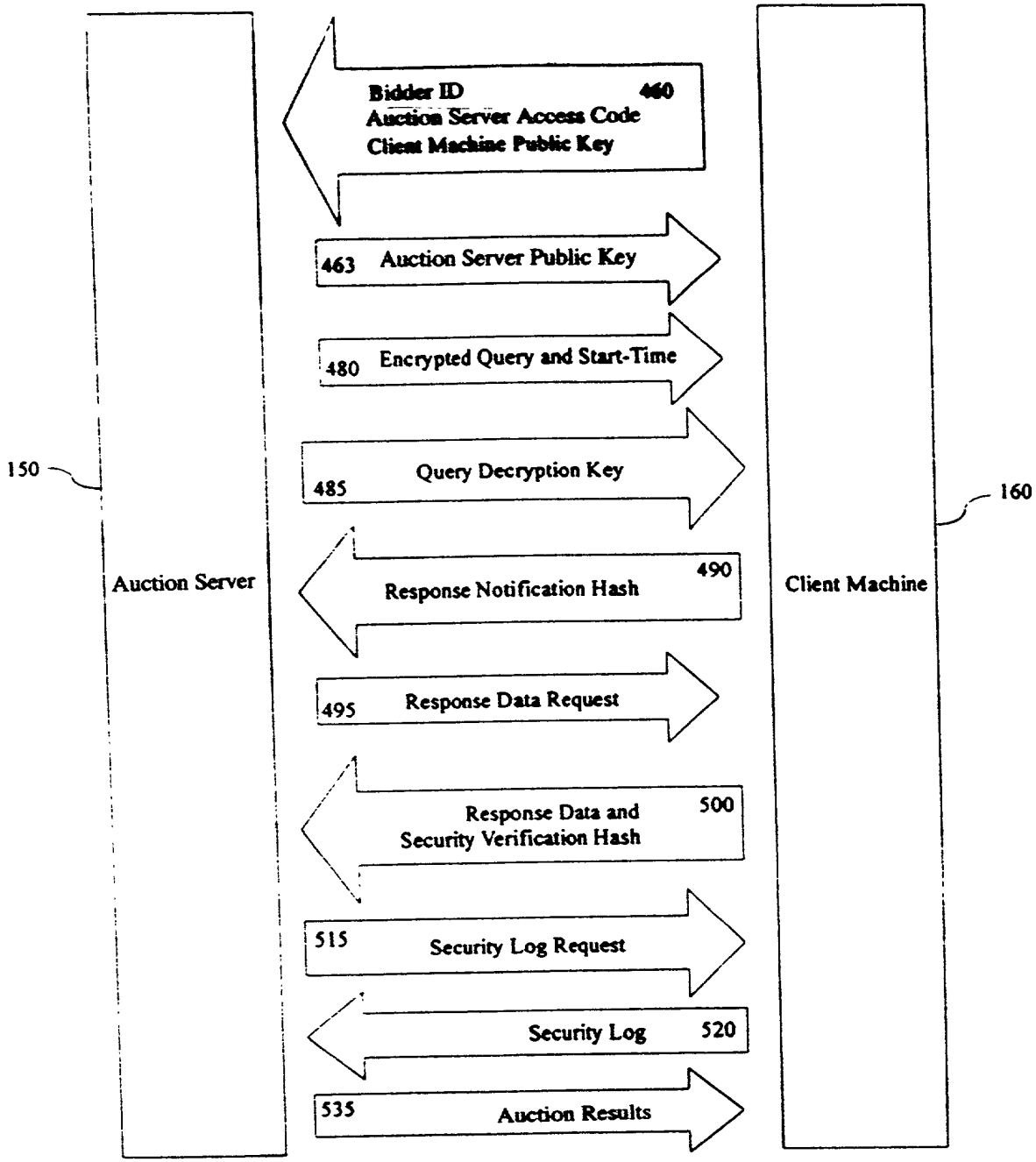

Auction Server
Client Machine
150
160
Bidder ID 460
Auction Server Access Code
Client Machine Public Key
463 Auction Server Public Key
480 Encrypted Query and Start-Time
485 Query Decryption Key
490 Response Notification Hash
495 Response Data Request
500 Response Data and Security Verification Hash
515 Security Log Request
520 Security Log
535 Auction Results

FIG. 7E

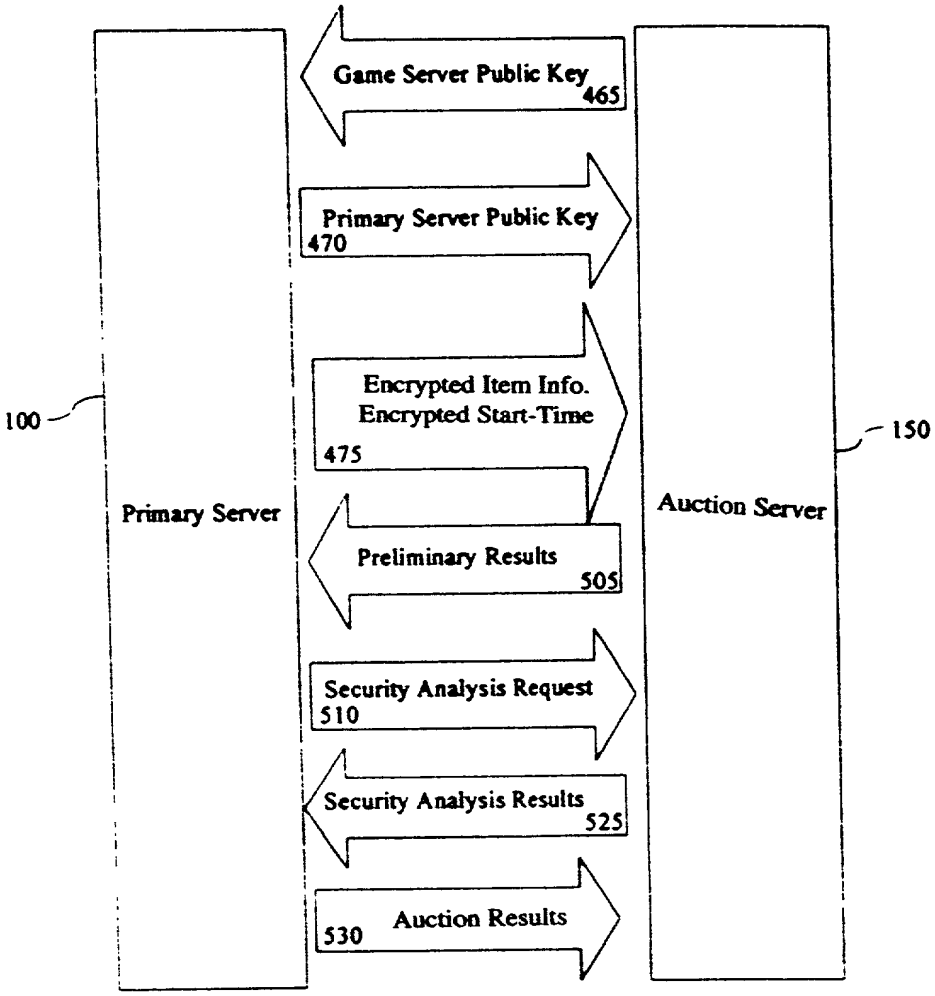

Game Server Public Key
465
Primary Server Public Key
470
Encrypted Item Info.
Encrypted Start-Time
475
Preliminary Results
505
Security Analysis Request
510
Security Analysis Results
525
Auction Results
530
100
Primary Server
150
Auction Server

FIG. 7F

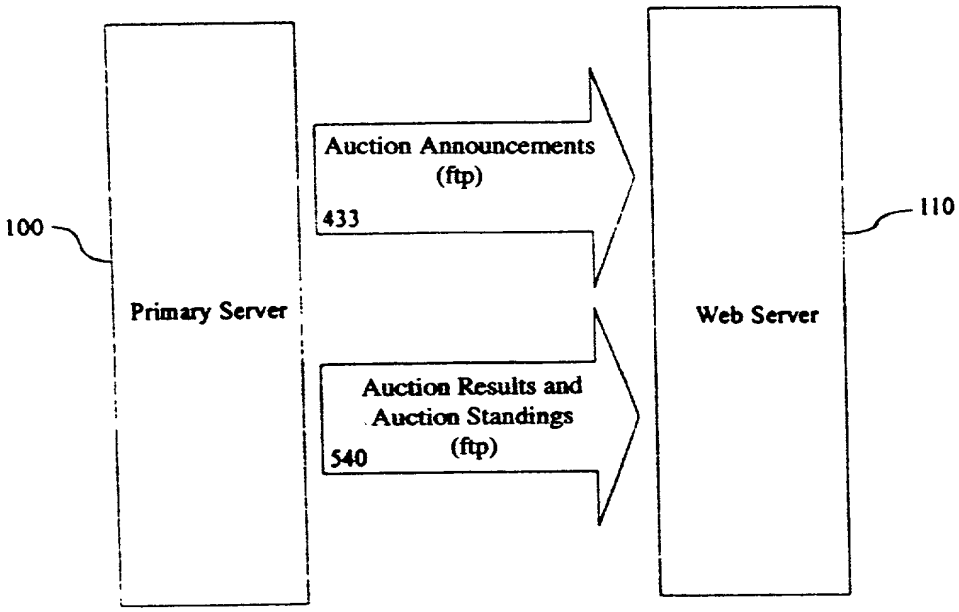

100
Primary Server
Auction Announcements
(ftp)
433
Auction Results and
Auction Standings
(ftp)
540
Web Server
110

FIG. 7G

LOGIN INFORMATION DATA FIELDS

USERNAME
PASSWORD
NAME
ADDRESS
EMAIL
CREDIT CARDS
CREDIT INFORMATION/RATING
UNIQUE IDENTIFICATION
NETWORK LATENCY HISTORY

FIG. 8A

BID HISTORY
AUCTION INFORMATION DATA FIELDS

ITEM NUMBER
DESCRIPTION
CATEGORY
MINIMUM SALE AMOUNT
BID INCREMENTS
START TIME
END TIME (IF APPLICABLE)
HIGHEST BID
ALL BID INFORMATION
OWNER
ADDRESS
EMAIL
PHONE
SALE HISTORY
BUYER COMMENTS

FIG. 8B

BID INFORMATION DATA FIELDS

USERNAME
UNIQUE IDENTIFICATION
SUBMISSION-TIME TIME STAMP
RECEIPT-TIME TIME STAMP
BID AMOUNT
VERIFICATION KEY

FIG. 8C

THE AUCTION PROCESS

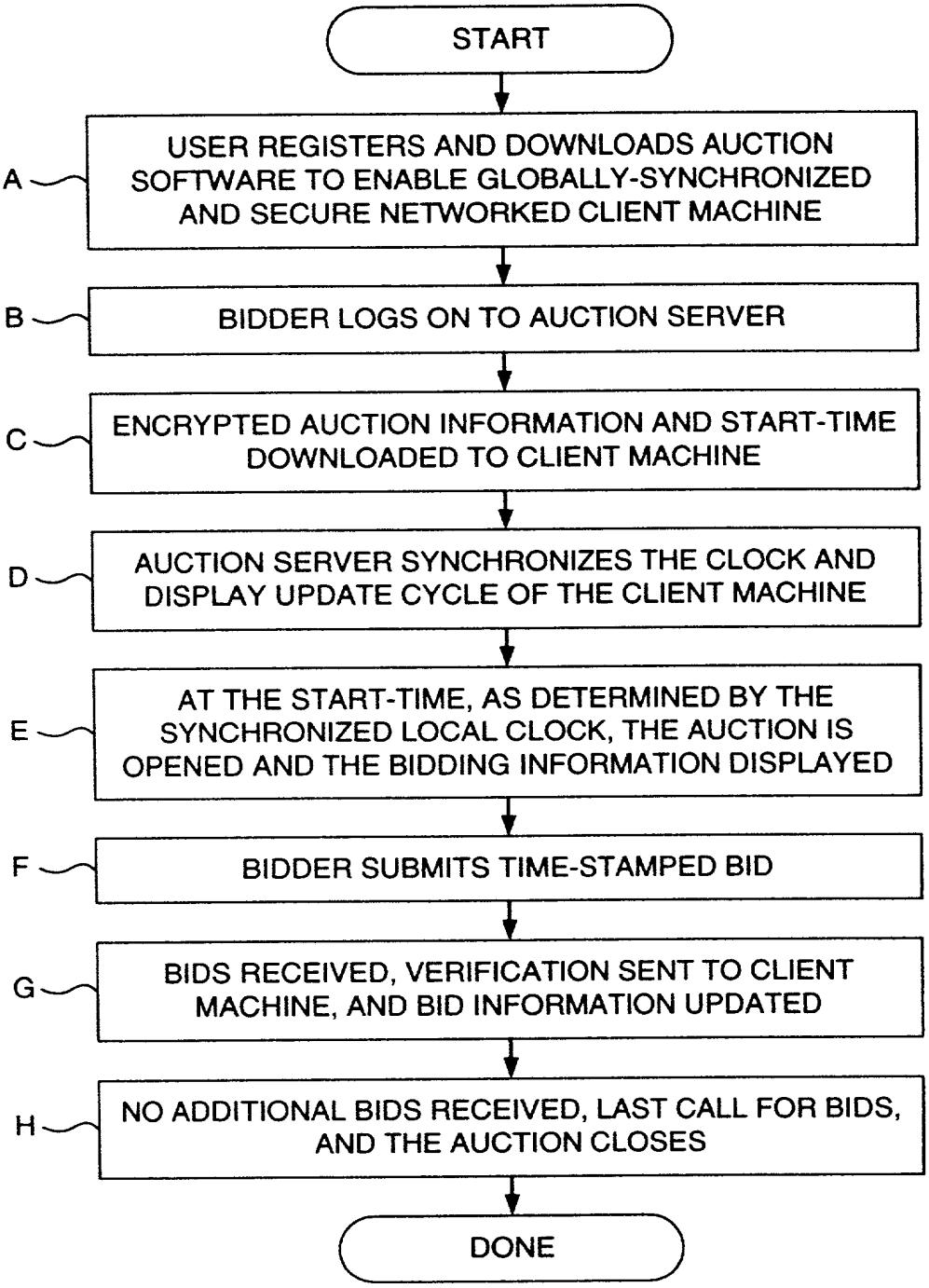


FIG. 9

USER REGISTERS AND DOWNLOADS AUCTION SOFTWARE

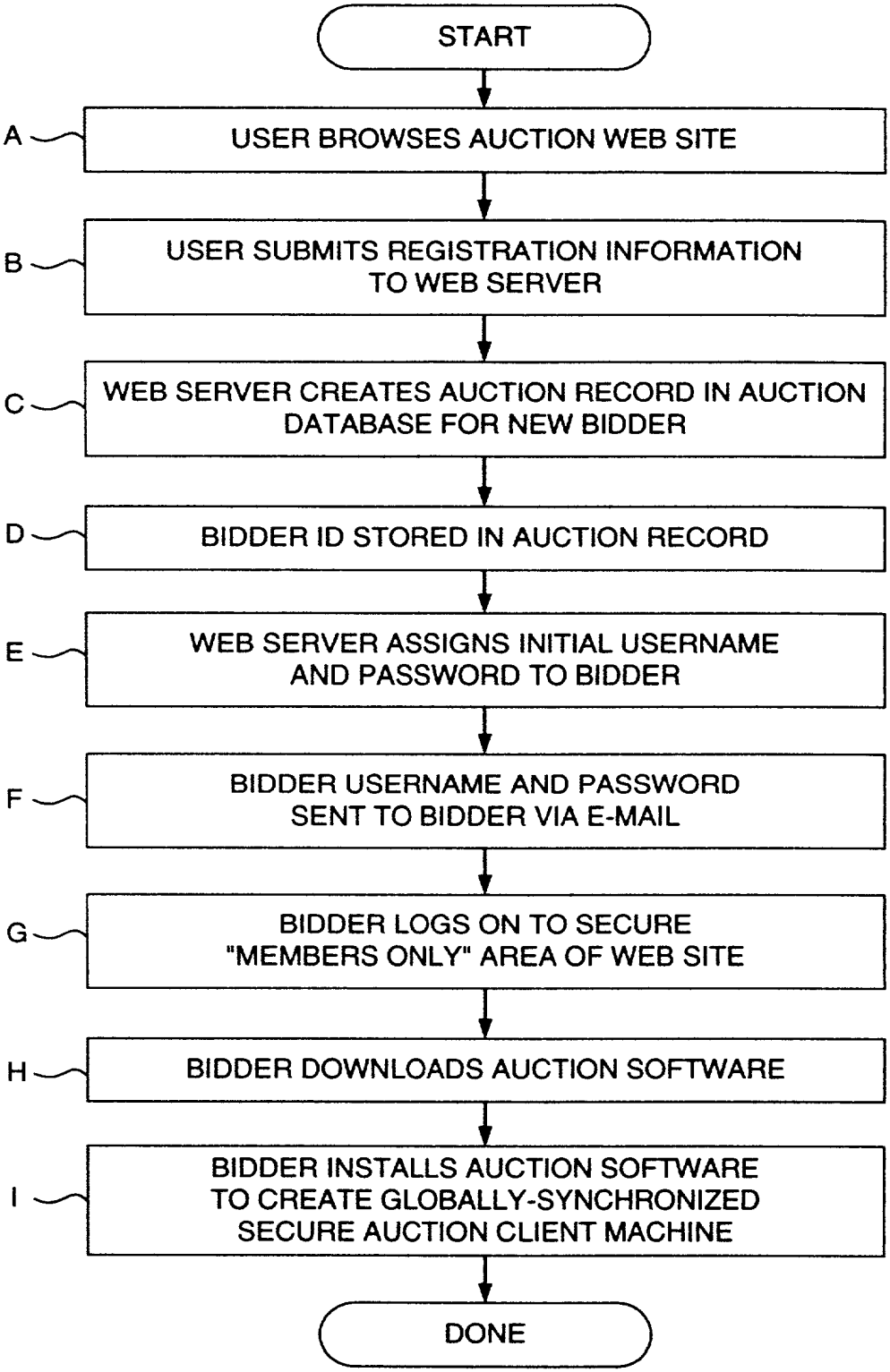


FIG. 9A

BIDDER LOGS ON TO AUCTION SERVER

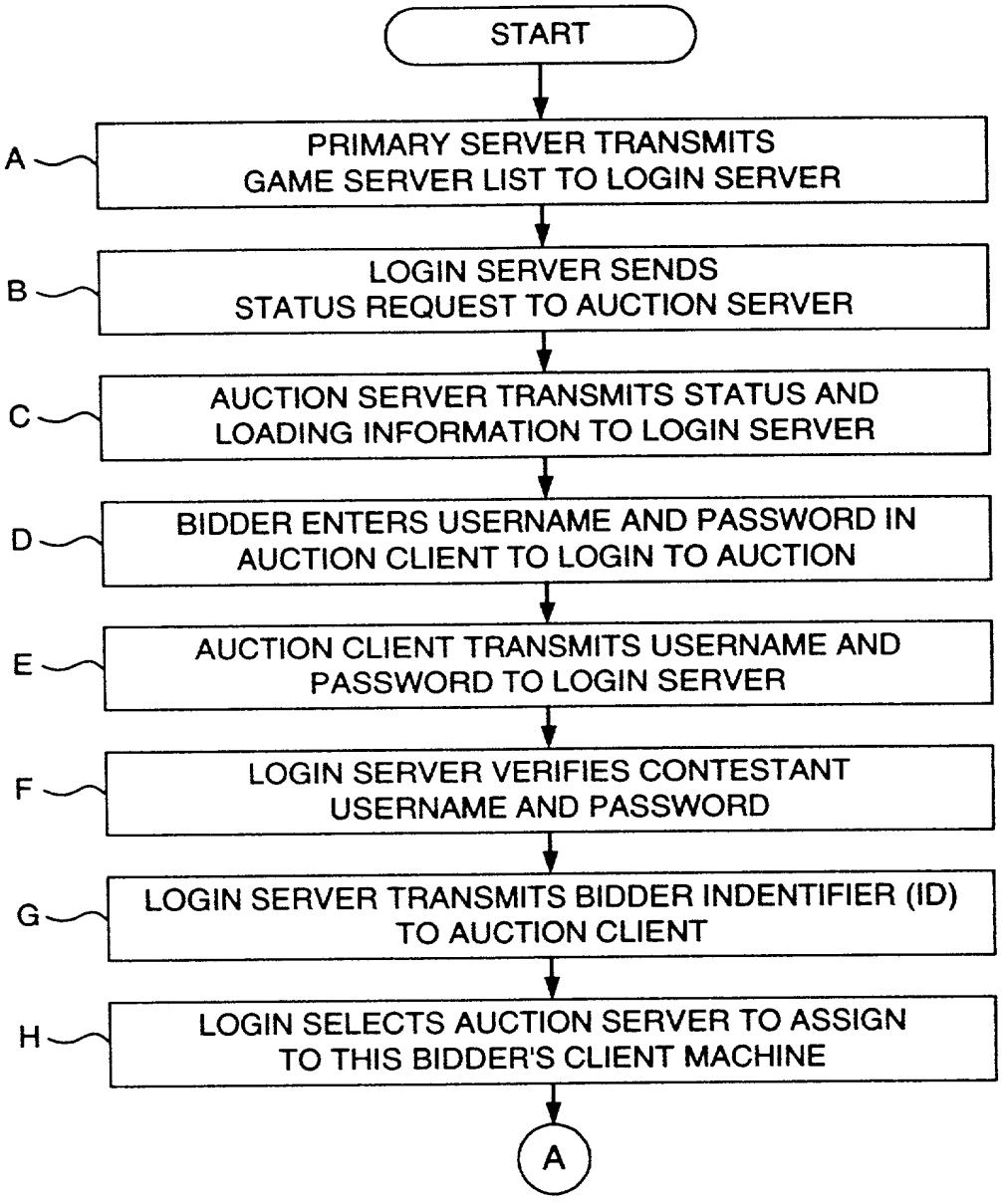


FIG. 9B1

Case 3:07-cv-04404-SI Document 1-10 Filed 08/20/2007

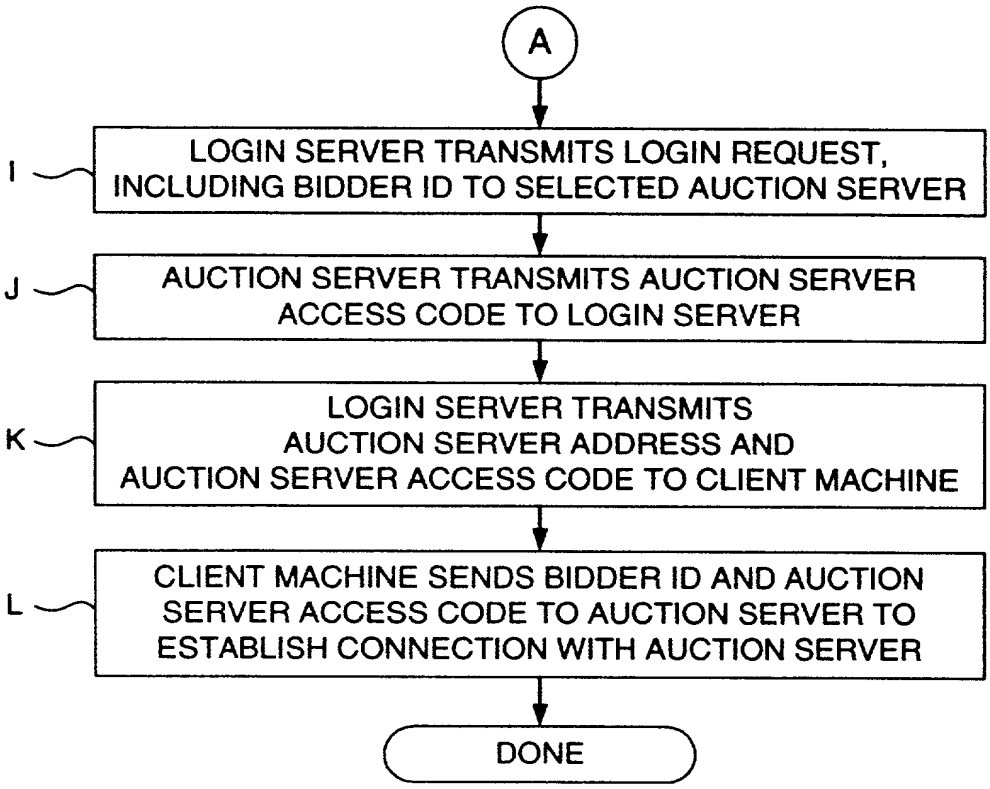

A
I
LOGIN SERVER TRANSMITS LOGIN REQUEST, INCLUDING BIDDER ID TO SELECTED AUCTION SERVER
J
AUCTION SERVER TRANSMITS AUCTION SERVER ACCESS CODE TO LOGIN SERVER
K
LOGIN SERVER TRANSMITS AUCTION SERVER ADDRESS AND AUCTION SERVER ACCESS CODE TO CLIENT MACHINE
L
CLIENT MACHINE SENDS BIDDER ID AND AUCTION SERVER ACCESS CODE TO AUCTION SERVER TO ESTABLISH CONNECTION WITH AUCTION SERVER
DONE

FIG. 9B2

ENCRYPTED AUCTION INFORMATION AND START-TIME DOWNLOADED TO CLIENT MACHINE

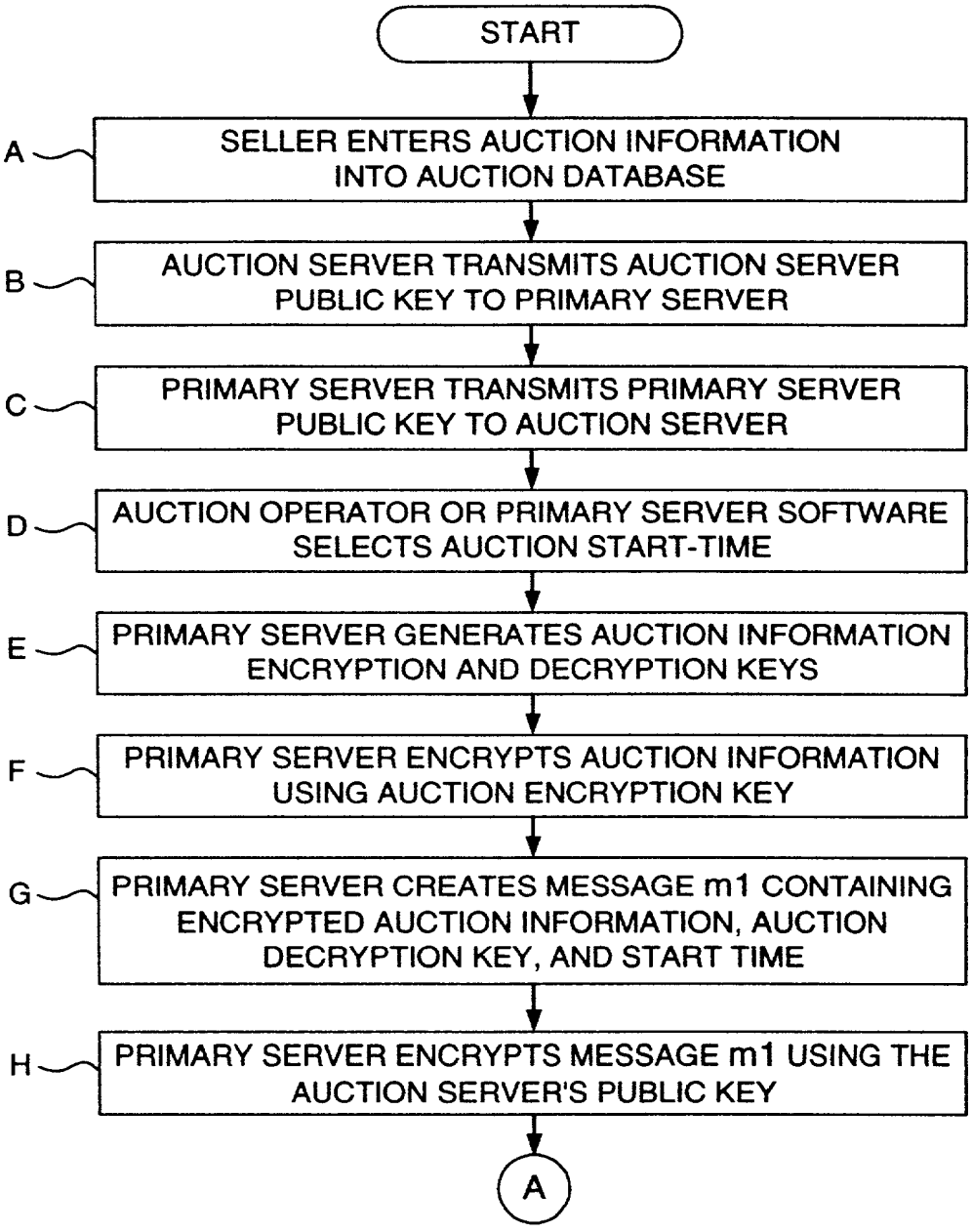


FIG. 9C1

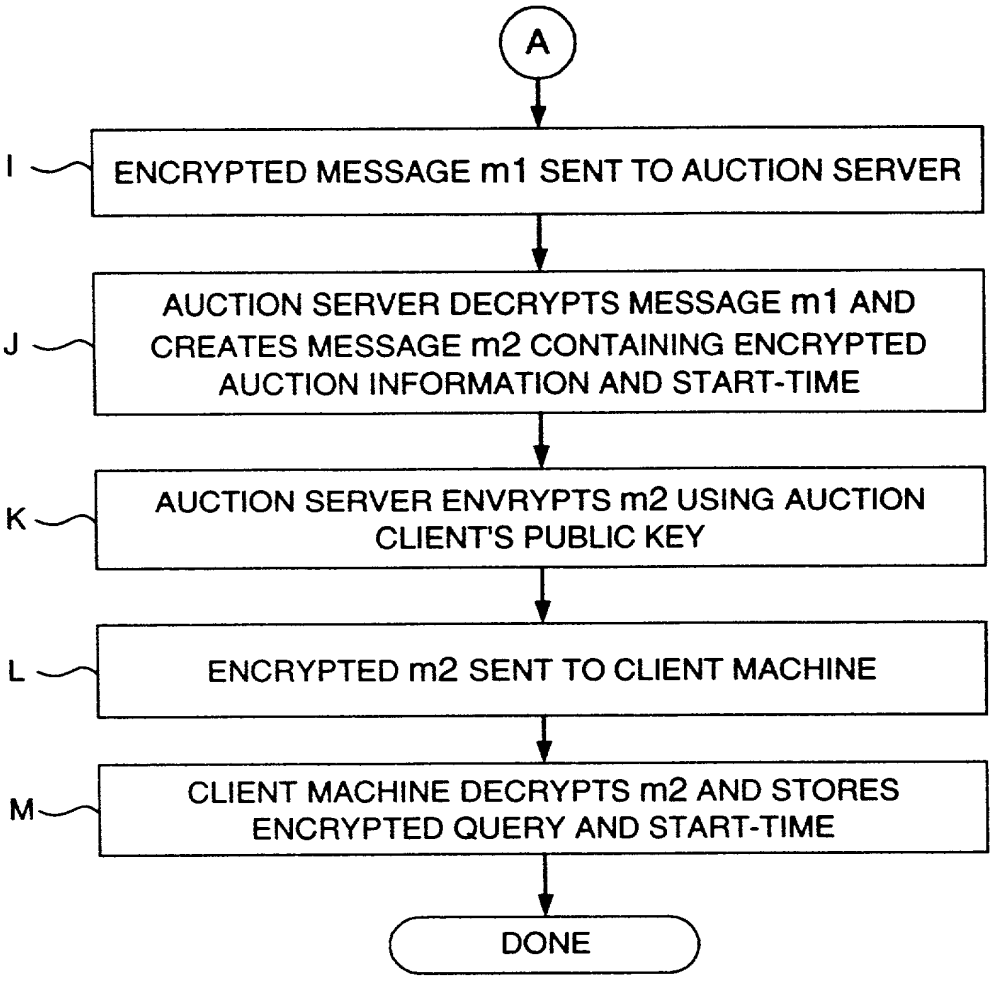

A
I
ENCRYPTED MESSAGE m1 SENT TO AUCTION SERVER
J
AUCTION SERVER DECRYPTS MESSAGE m1 AND CREATES MESSAGE m2 CONTAINING ENCRYPTED AUCTION INFORMATION AND START-TIME
K
AUCTION SERVER ENVRYPTS m2 USING AUCTION CLIENT'S PUBLIC KEY
L
ENCRYPTED m2 SENT TO CLIENT MACHINE
M
CLIENT MACHINE DECRYPTS m2 AND STORES ENCRYPTED QUERY AND START-TIME
DONE

FIG. 9C2

AUCTION SERVER SYNCHRONIZES THE CLOCK AND DISPLAY UPDATE CYCLE OF THE CLIENT MACHINE

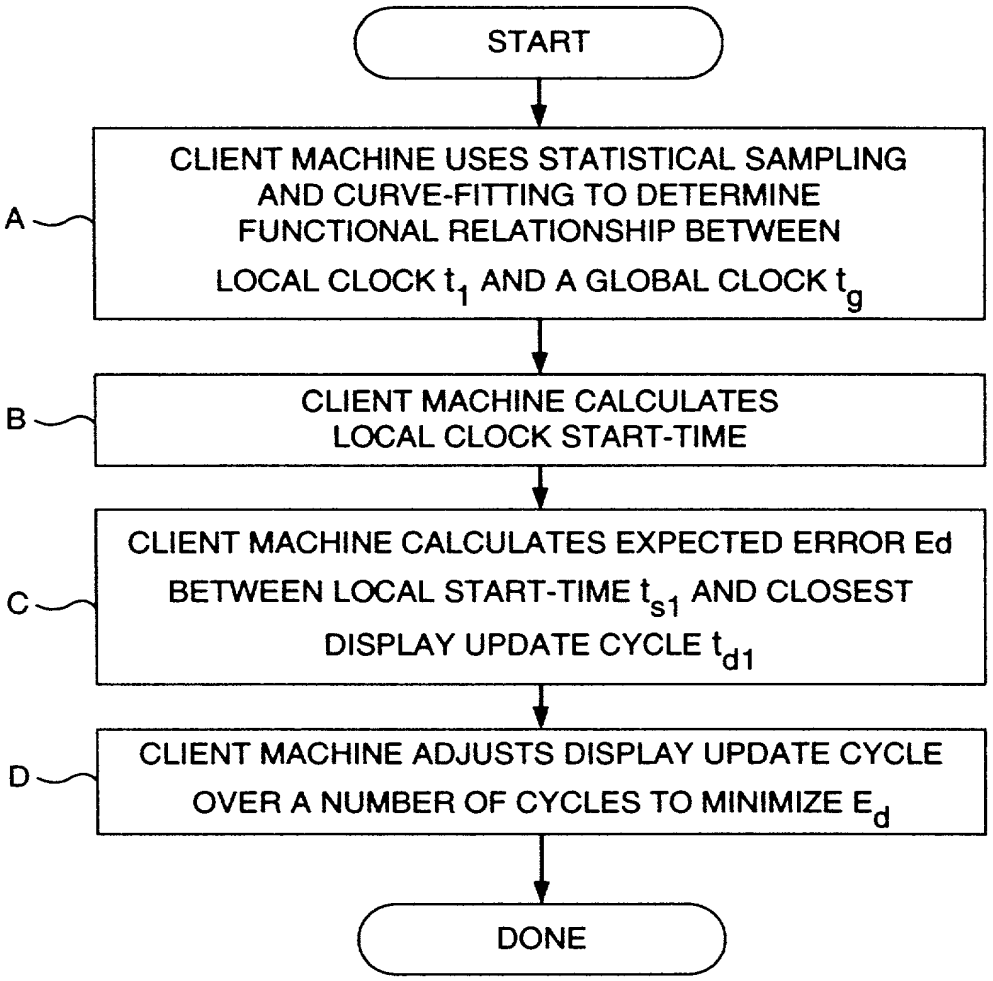


FIG. 9D

HIGH LEVEL BIDDING PROCESS

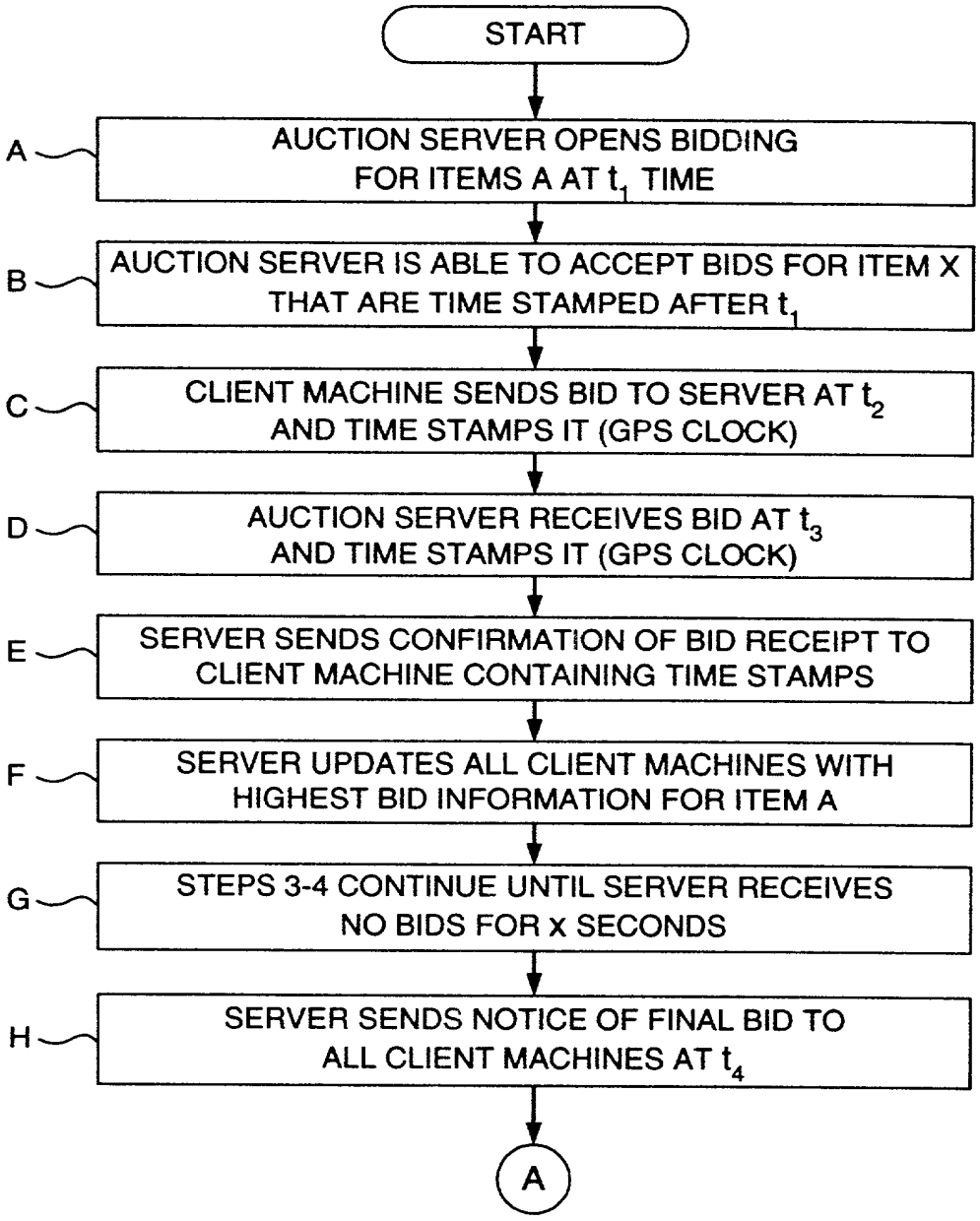


FIG. 9E1

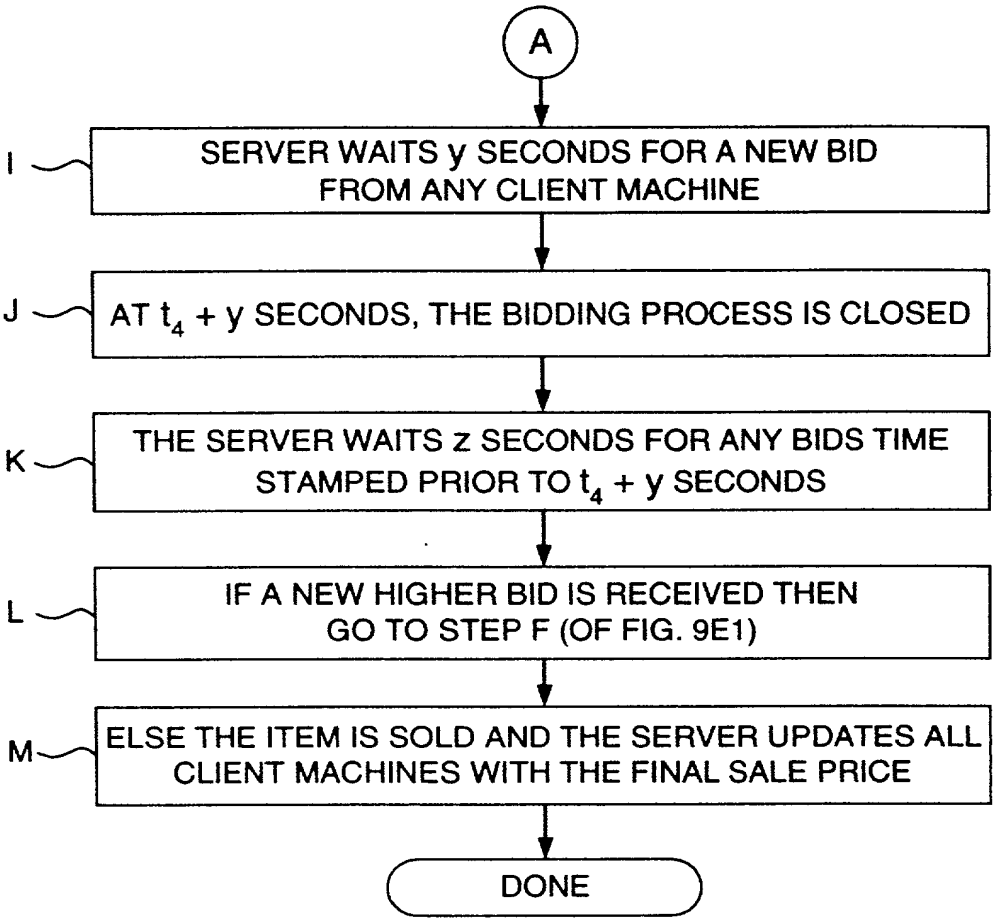

A
I
SERVER WAITS y SECONDS FOR A NEW BID FROM ANY CLIENT MACHINE
J
AT t_4 + y SECONDS, THE BIDDING PROCESS IS CLOSED
K
THE SERVER WAITS z SECONDS FOR ANY BIDS TIME STAMPED PRIOR TO t_4 + y SECONDS
L
IF A NEW HIGHER BID IS RECEIVED THEN GO TO STEP F (OF FIG. 9E1)
M
ELSE THE ITEM IS SOLD AND THE SERVER UPDATES ALL CLIENT MACHINES WITH THE FINAL SALE PRICE
DONE

FIG. 9E2

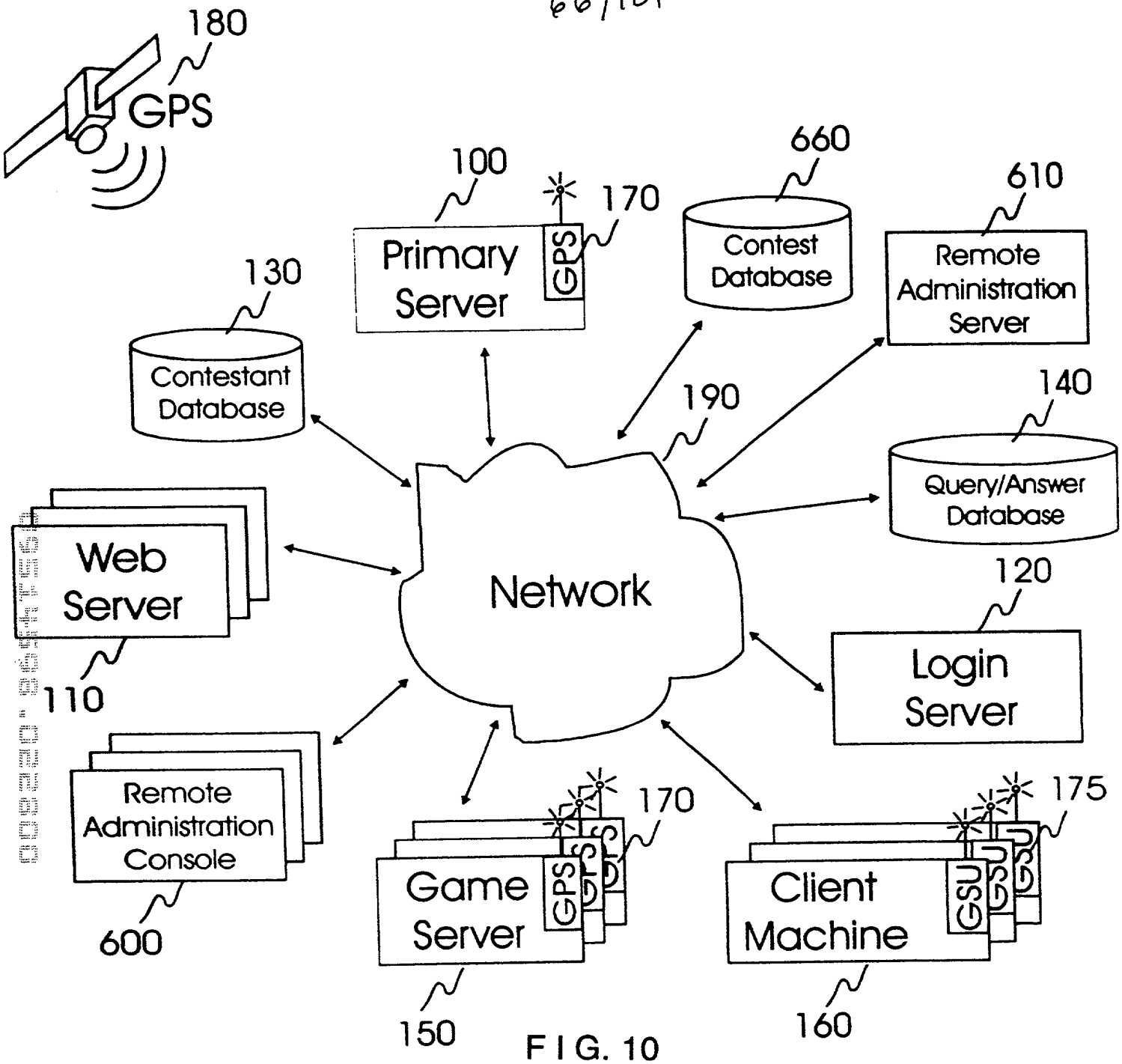

180
GPS
100
Primary Server
GPS
170
660
Contest Database
610
Remote Administration Server
130
Contestant Database
190
140
Query/Answer Database
Network
Web Server
110
120
Login Server
Remote Administration Console
600
Game Server
GPS
170
150
Client Machine
GPS
175
160

FIG. 10

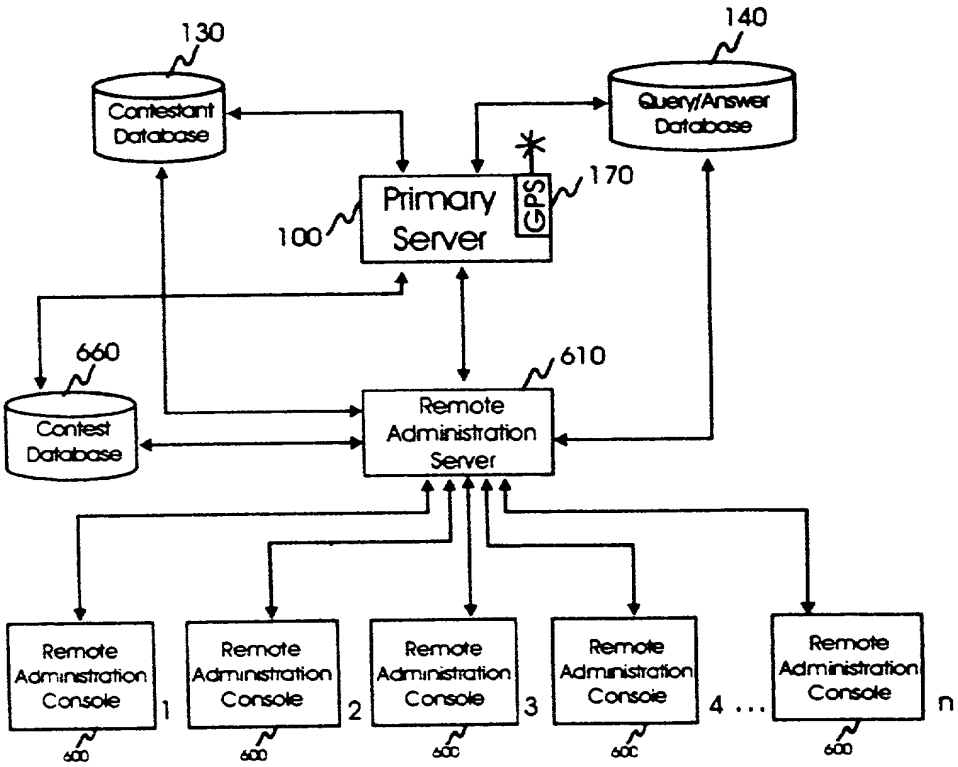

130
Contestant Database
140
Query/Answer Database
Primary Server
GPS
170
100
660
Contest Database
610
Remote Administration Server
Remote Administration Console
1
2
3
4 ...
n
600

FIG. 10A

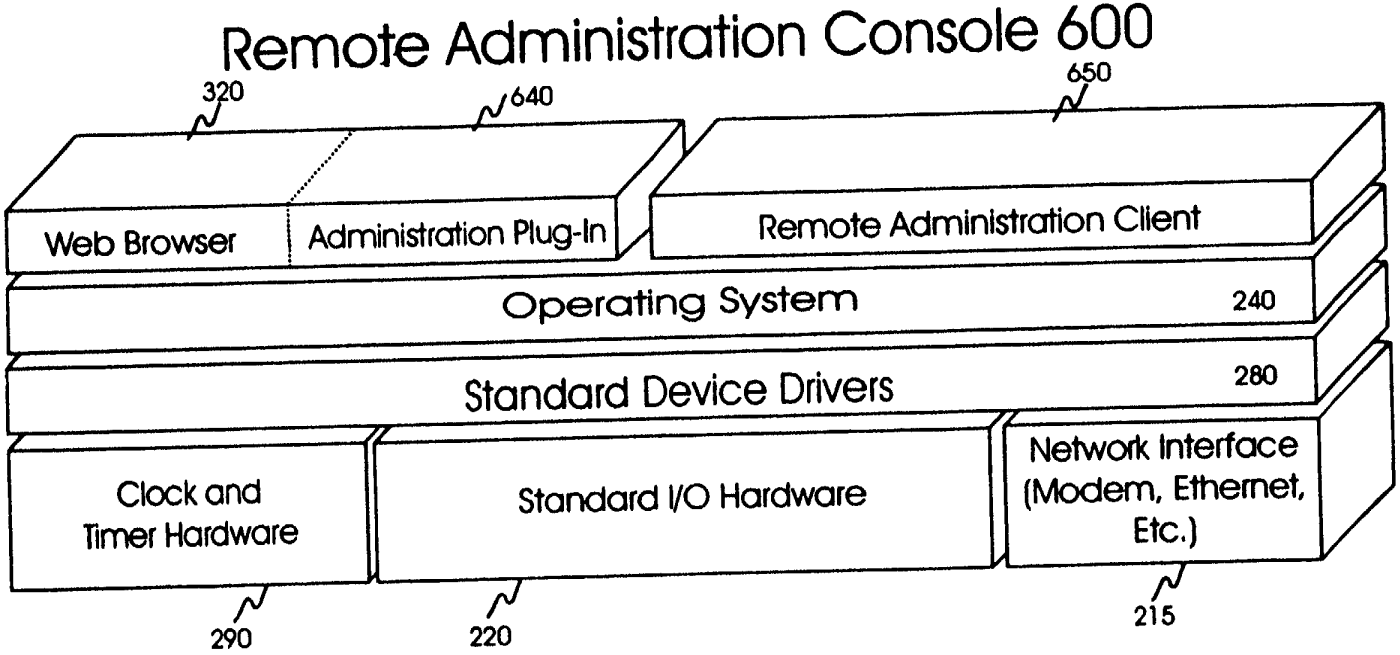

Remote Administration Console 600
320
640
650
Web Browser
Administration Plug-In
Remote Administration Client
Operating System
240
Standard Device Drivers
280
Clock and Timer Hardware
Standard I/O Hardware
Network Interface (Modem, Ethernet, Etc.)
290
220
215

FIG. 10B

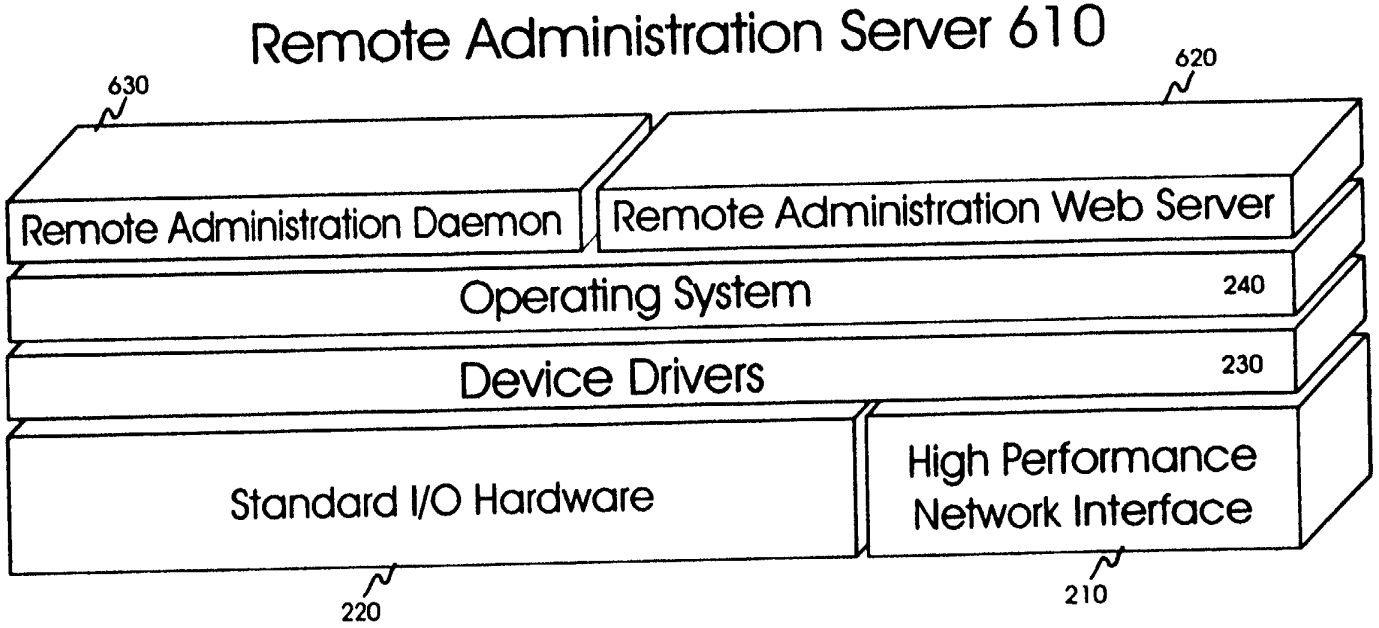

Remote Administration Server 610
630
620
Remote Administration Daemon
Remote Administration Web Server
Operating System
240
Device Drivers
230
Standard I/O Hardware
High Performance
Network Interface
220
210

FIG. 10C

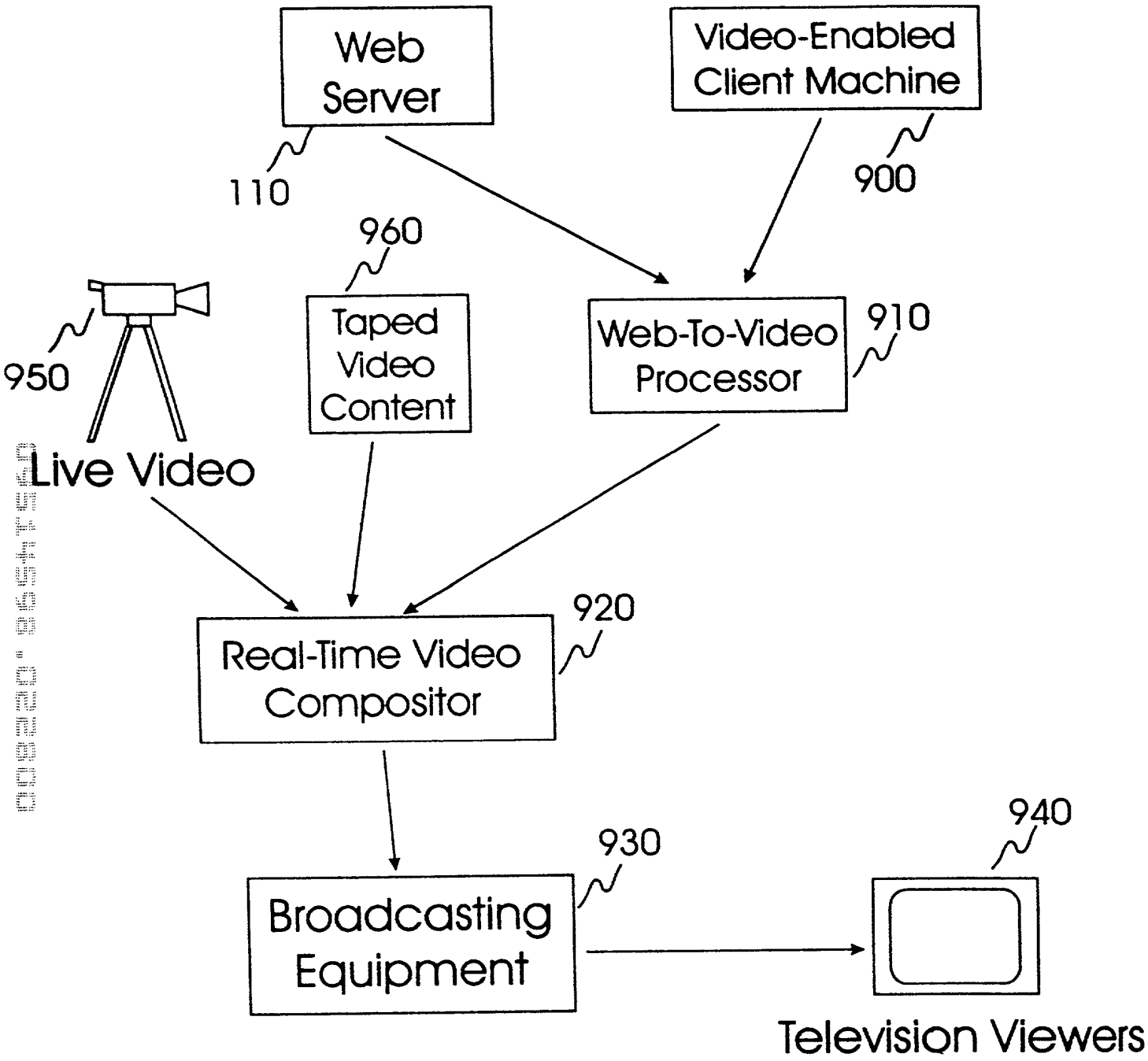

Web Server
110
Video-Enabled Client Machine
900
960
Taped Video Content
Web-To-Video Processor
910
950
Live Video
920
Real-Time Video Compositor
930
Broadcasting Equipment
940
Television Viewers

FIG. 11

09320 "SEARCH"

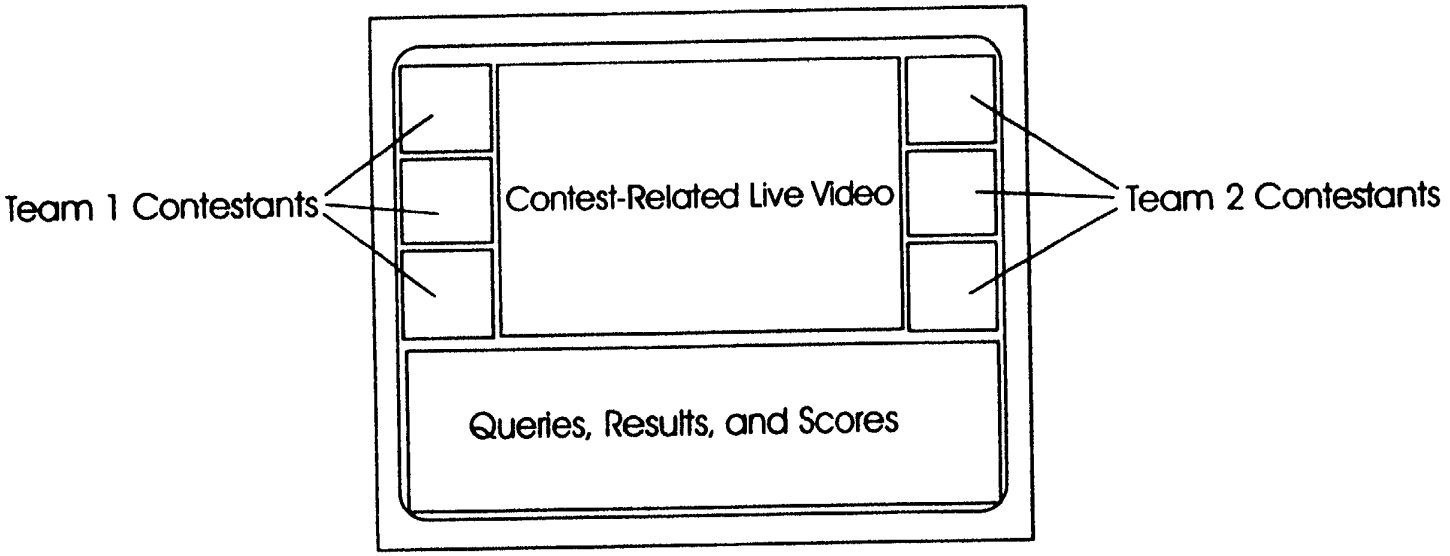


FIG. 11A

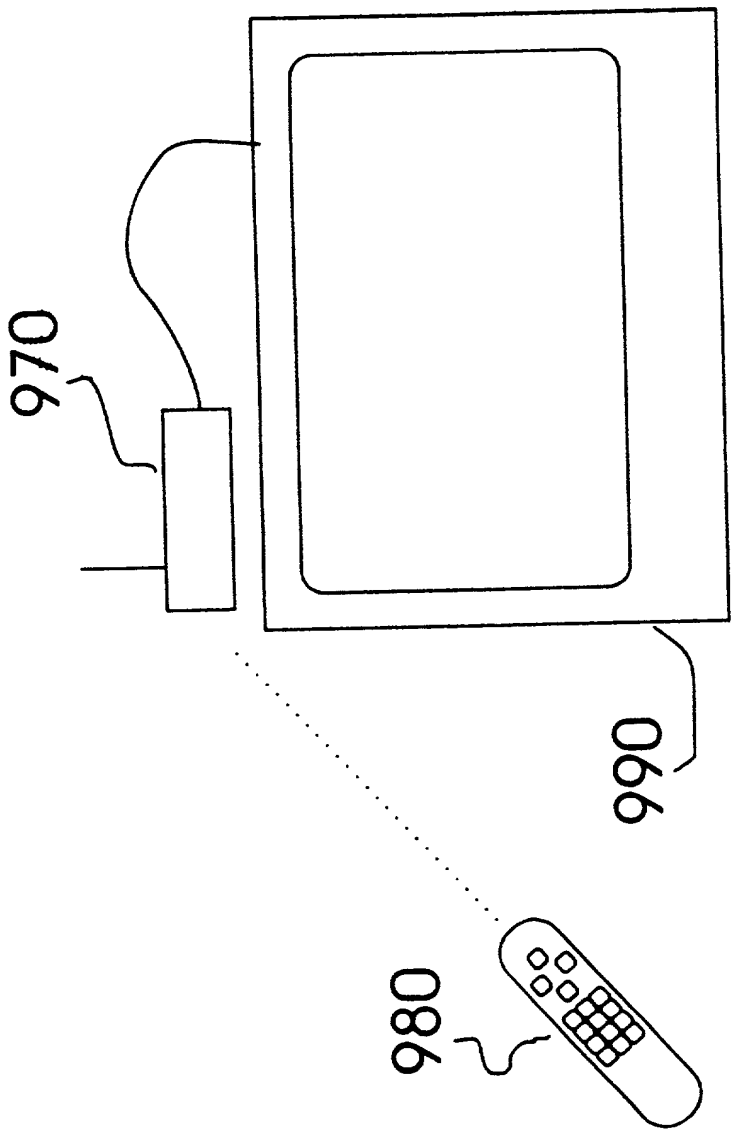


FIG. 12

09830 "9654T520

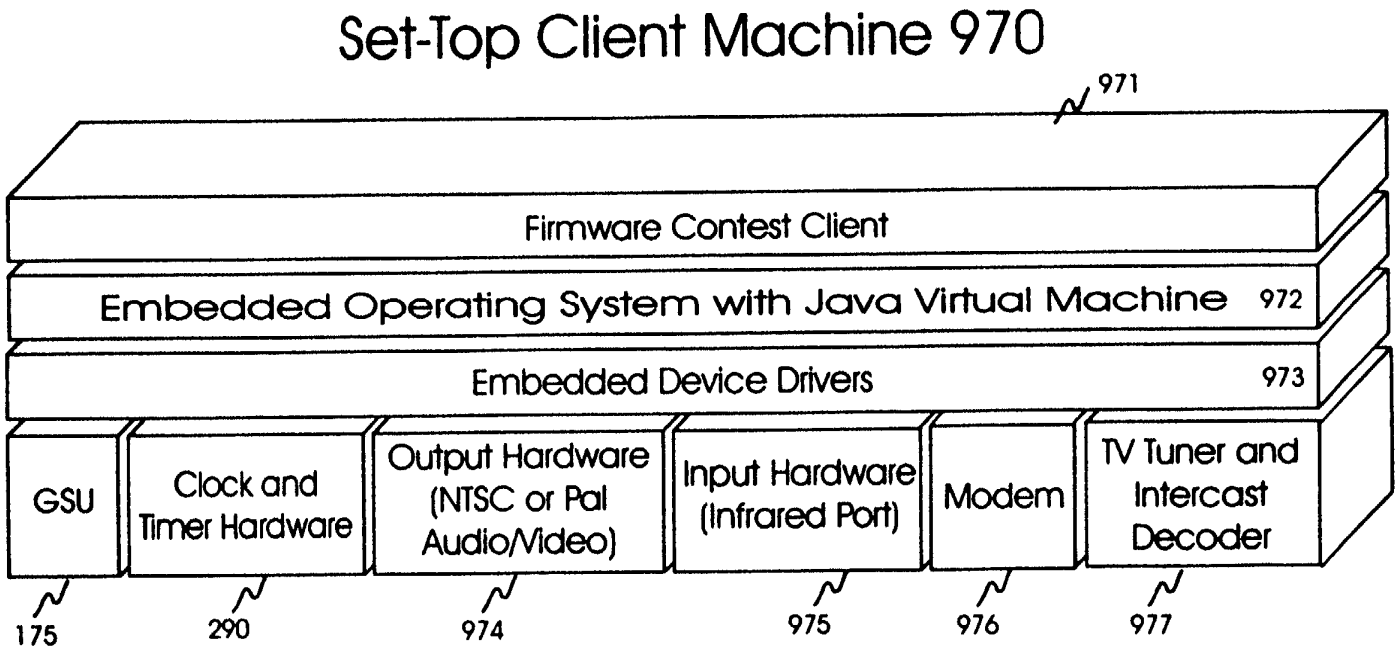


FIG. 12A

Examples of GSU Inputs for Time and Space Stamping

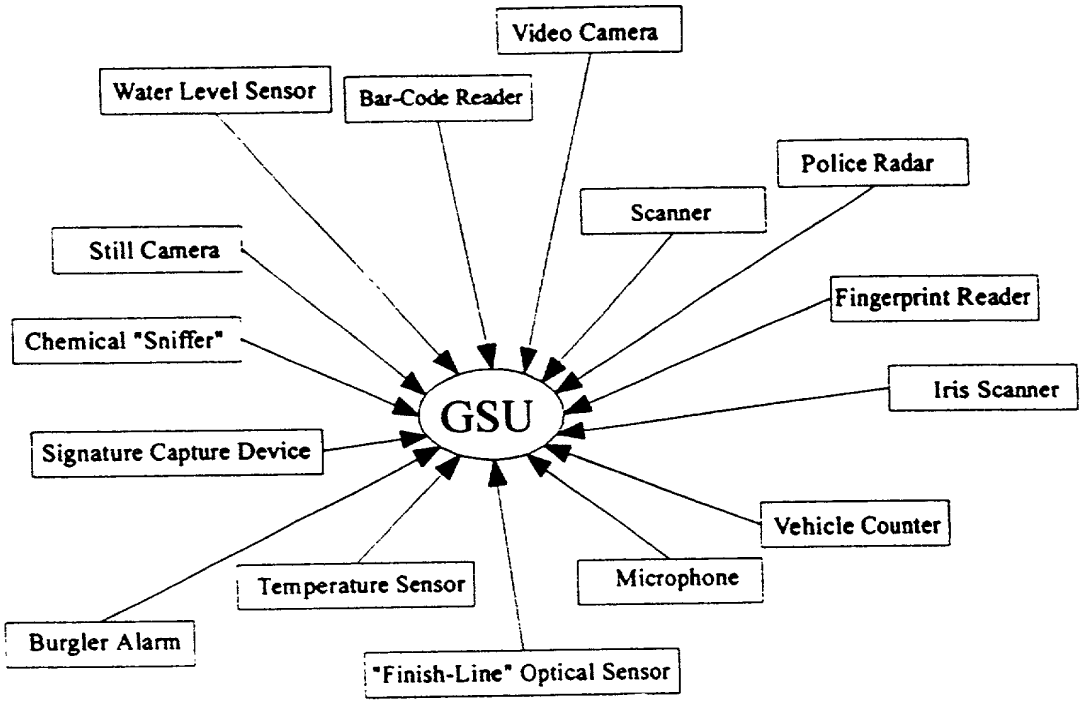
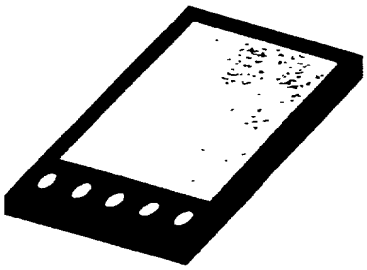
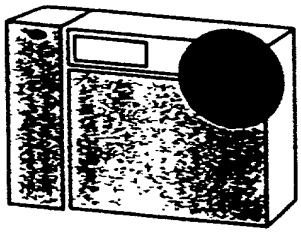


FIG. 13

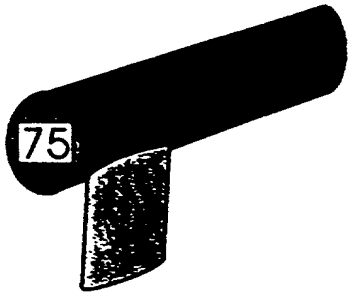
Embedded GSU Applications



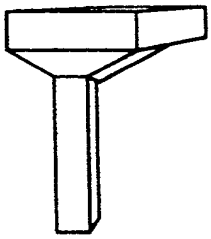
Handheld Computer



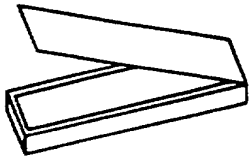
Digital Camera



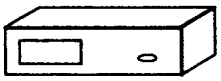
Police Radar



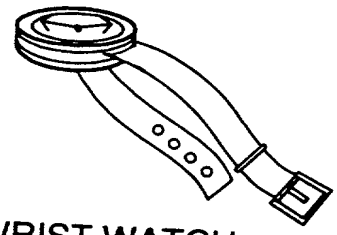
Bar Code Scanner



Scanner



CABLE TV SET-TOP BOXES



WRIST WATCH

FIG. 14

Peripheral GSU Configurations

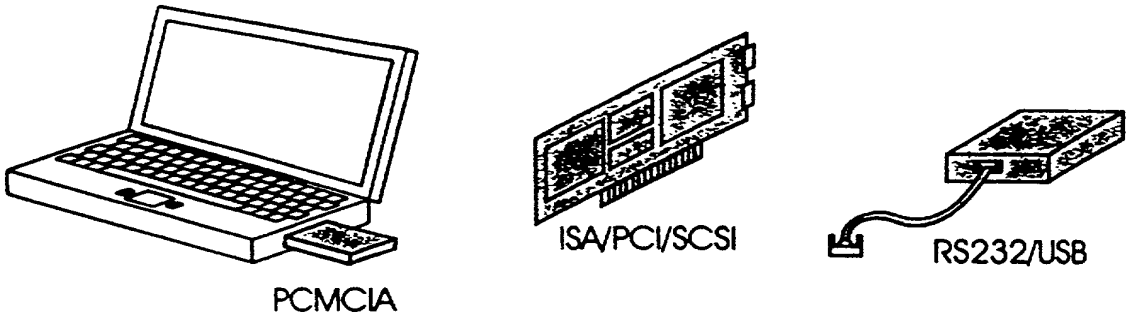


FIG. 15

09754508 - 020900

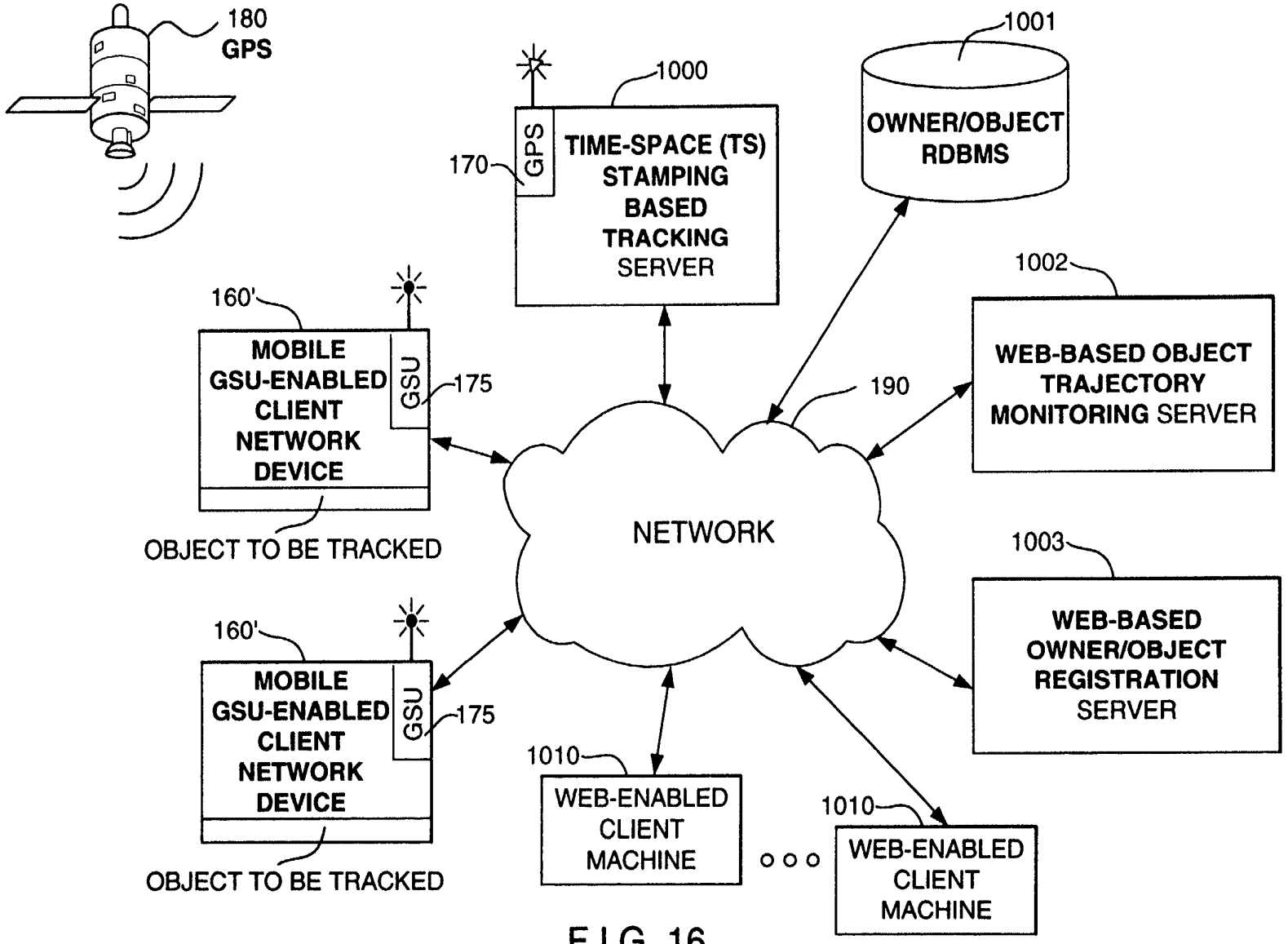

180
GPS
1000
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001
OWNER/OBJECT RDBMS
1002
WEB-BASED OBJECT TRAJECTORY MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
OBJECT TO BE TRACKED
190
NETWORK
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
OBJECT TO BE TRACKED
1003
WEB-BASED OWNER/OBJECT REGISTRATION SERVER
1010
WEB-ENABLED CLIENT MACHINE
1010
WEB-ENABLED CLIENT MACHINE

FIG. 16

GSU-ENABLED CLIENT NETWORK DEVICE 160'

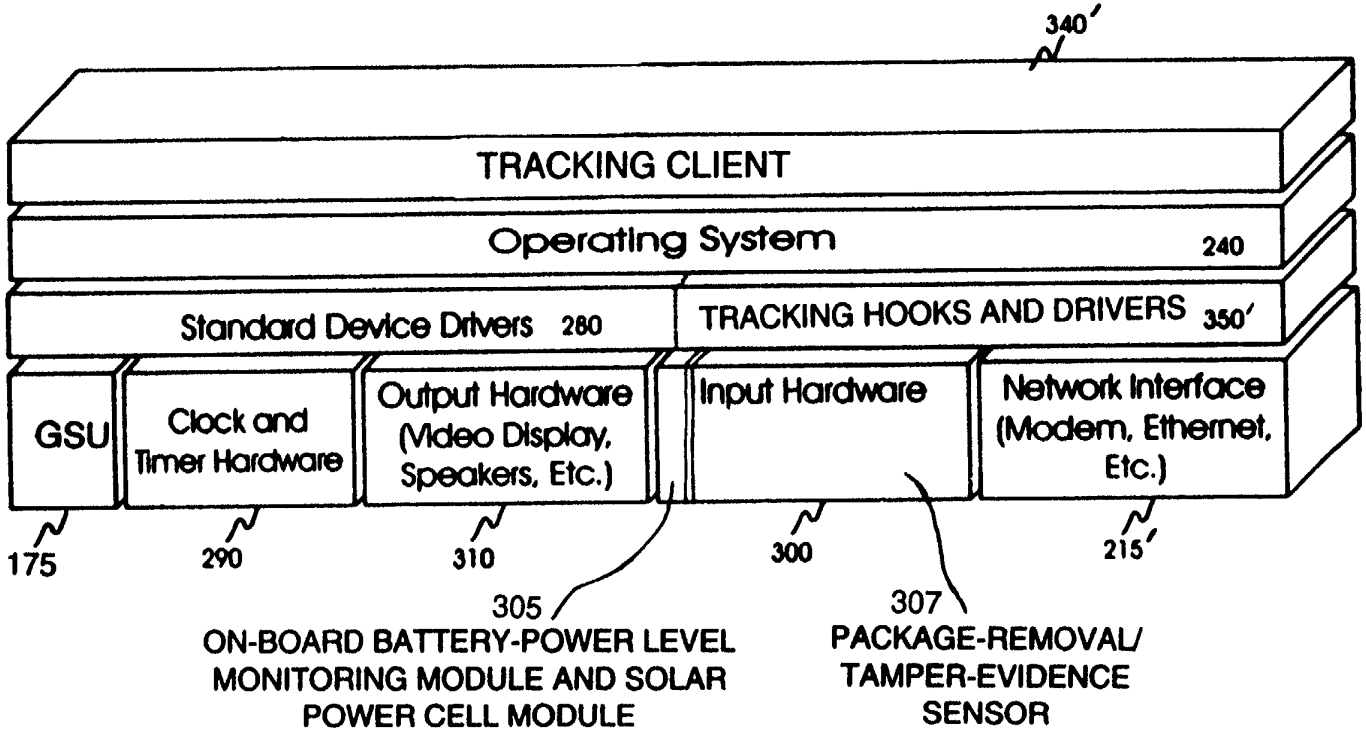


FIG. 16A

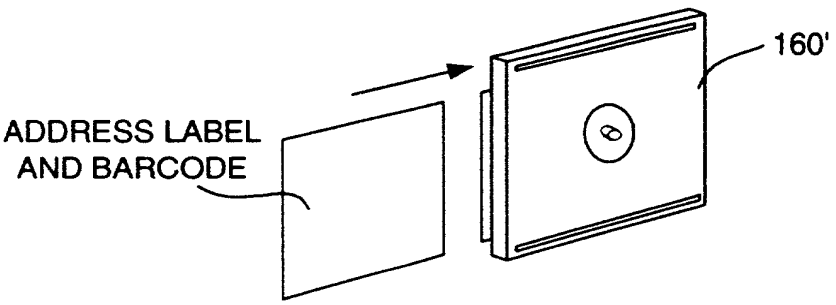


FIG. 16A1

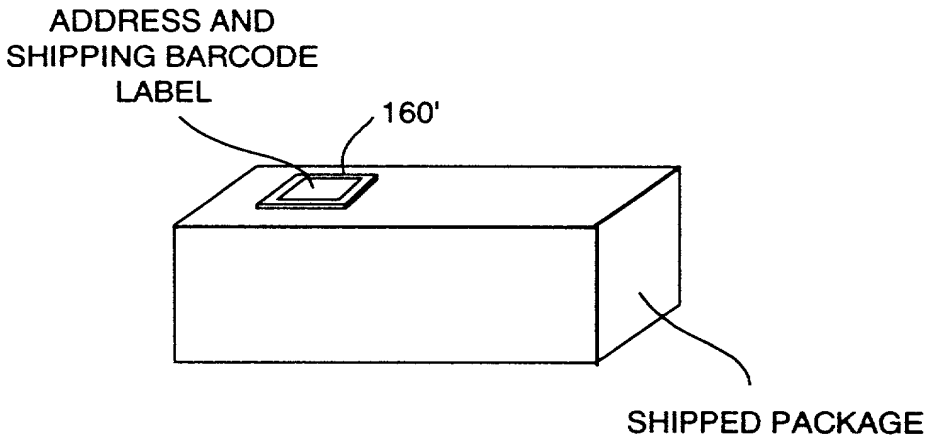


FIG. 16A2

TS-STAMPING BASED TRACKING SERVER 1000

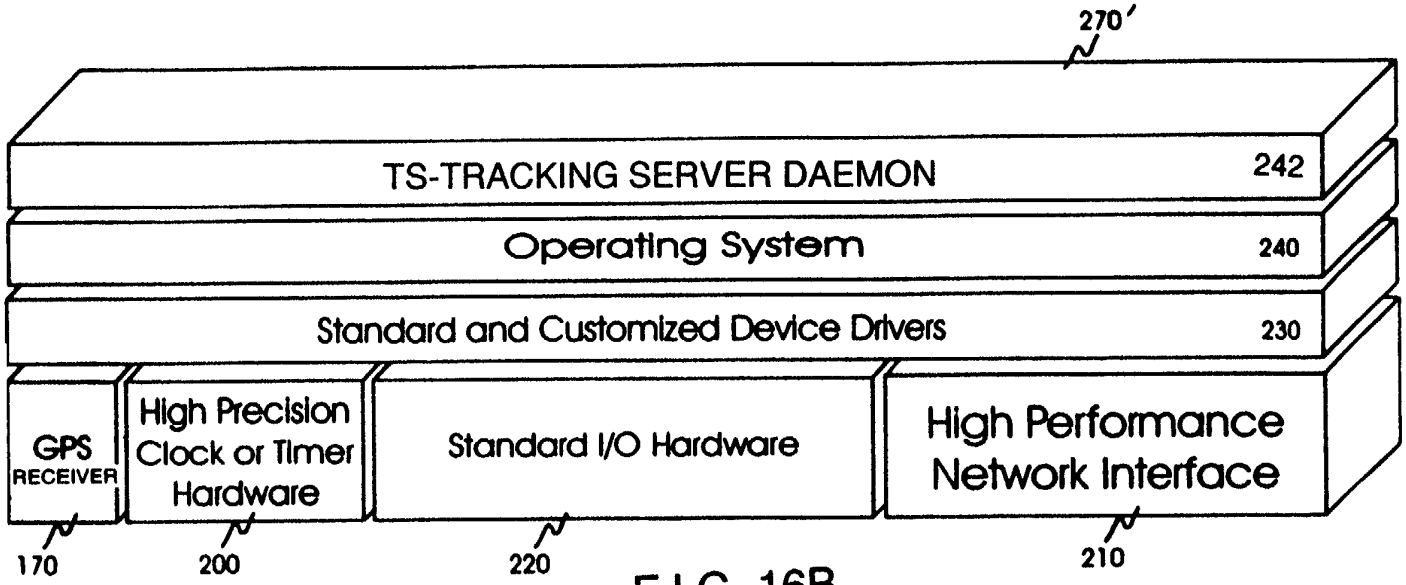


FIG. 16B

09829 "PCT/US

WEB-BASED OWNER/OBJECT REGISTRATION SERVER 1003

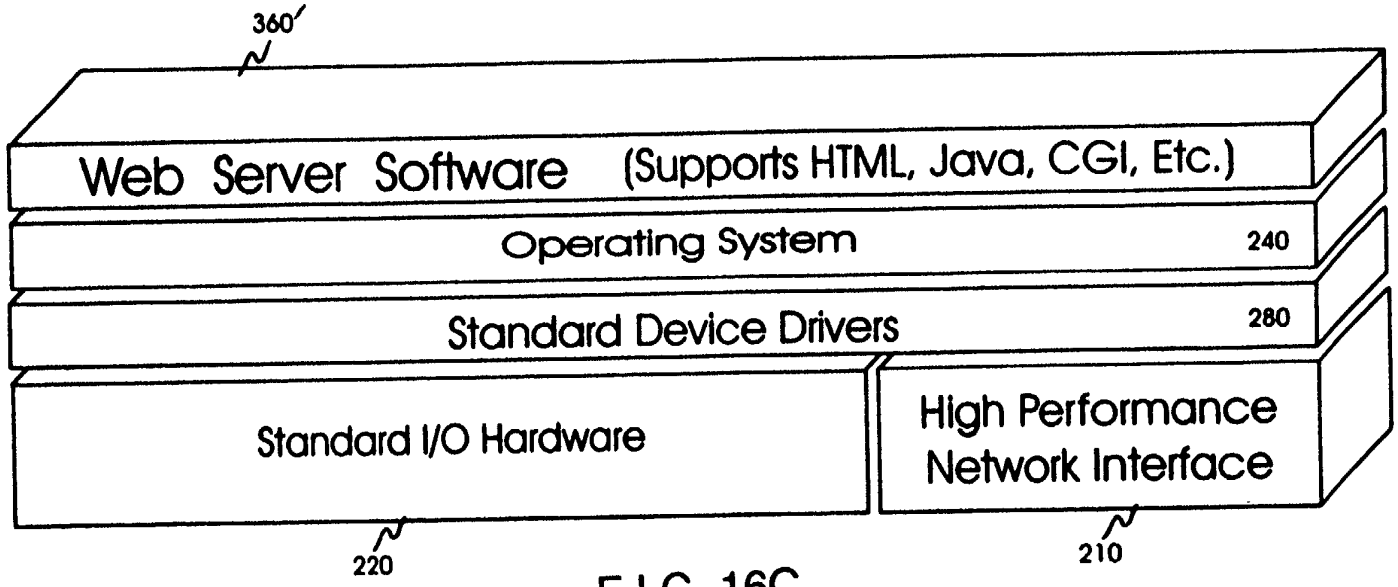


FIG. 16C

WEB-BASED OBJECT TRAJECTORY MONITORING SERVER 1002

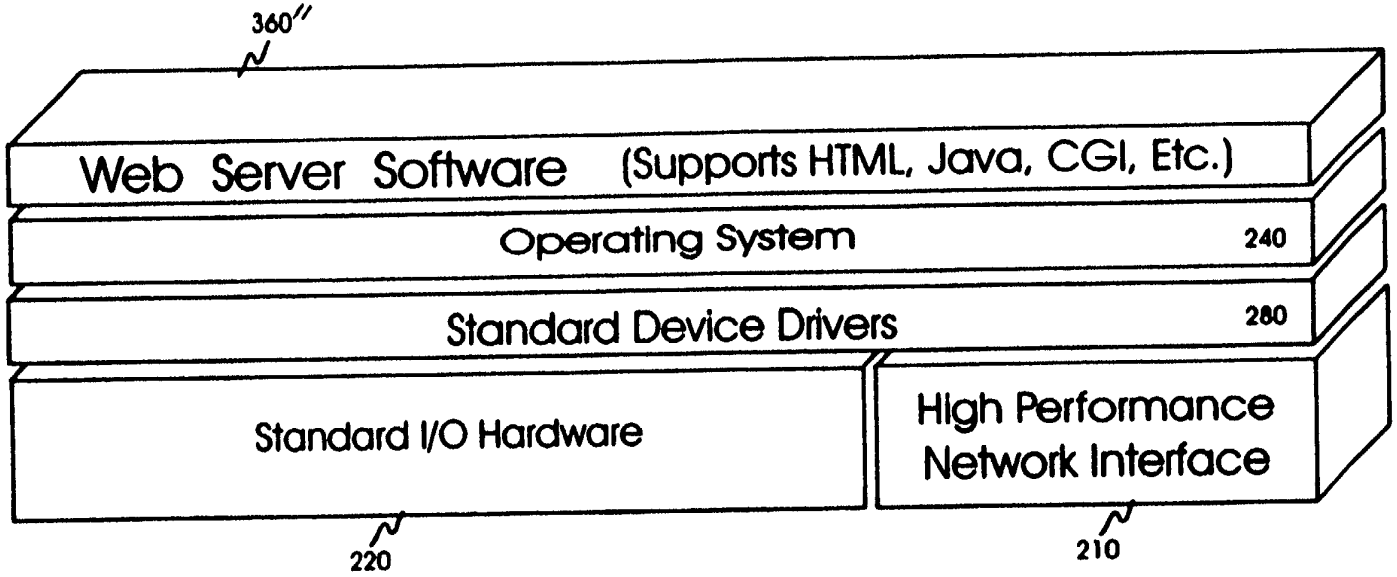
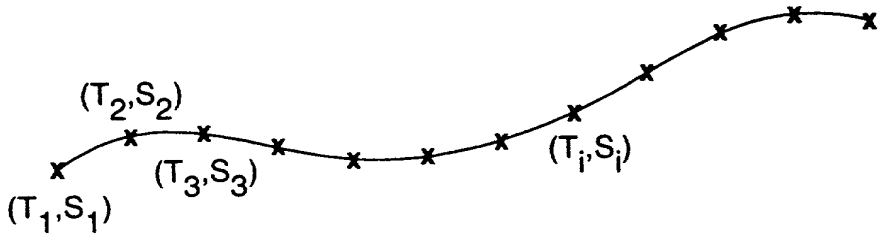


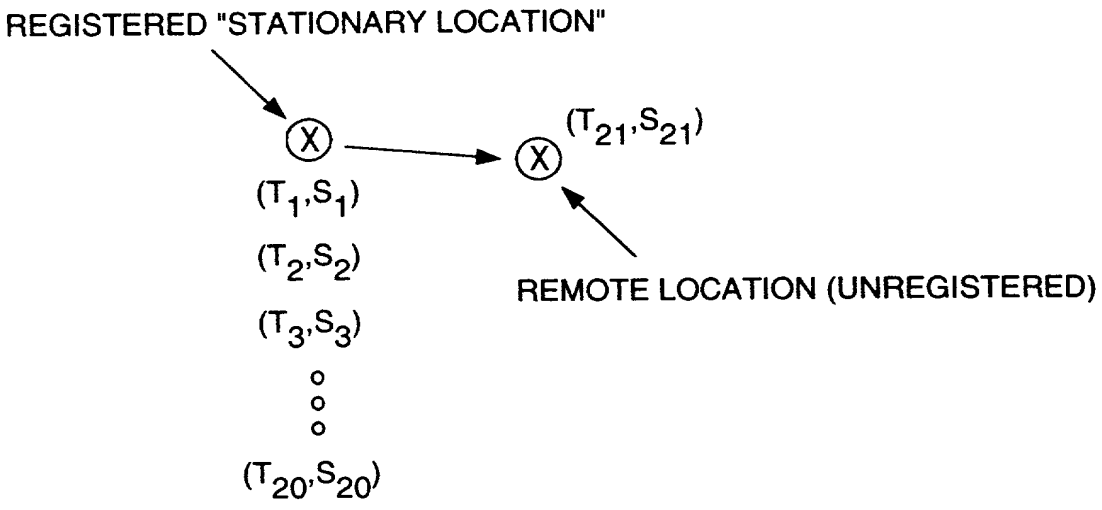
FIG. 16D

TIME-SPACE (T,S) COORDINATE TRACKING OF MOBILE OBJECTS



F I G. 17A

TIME-SPACE (T,S) STAMPING OF STATIONARY OBJECTS TO DETECT MOVEMENT THEREOF



F I G. 17B

OWNER/OBJECT DATABASE TABLE

OBJECT NAME	OBJECT OWNER	GSU'S UNIQUE ID CODE (UIC)	TIME-SPACE STAMP		TIME-SPACE STAMP
TOM SMITH	TOM SMITH	1567N2B0	(T_1,S_1)		(T_i,S_i)
JERRY DOG	TOM SMITH	1568N2B0	(T_1,S_1)		(T_i,S_i)
VOLVO S80	TOM SMITH	1569N2B0	(T_1,S_1)		(T_i,S_i)
o o o	o o o	o o o	o o o	ooo	o o o

FIG. 18

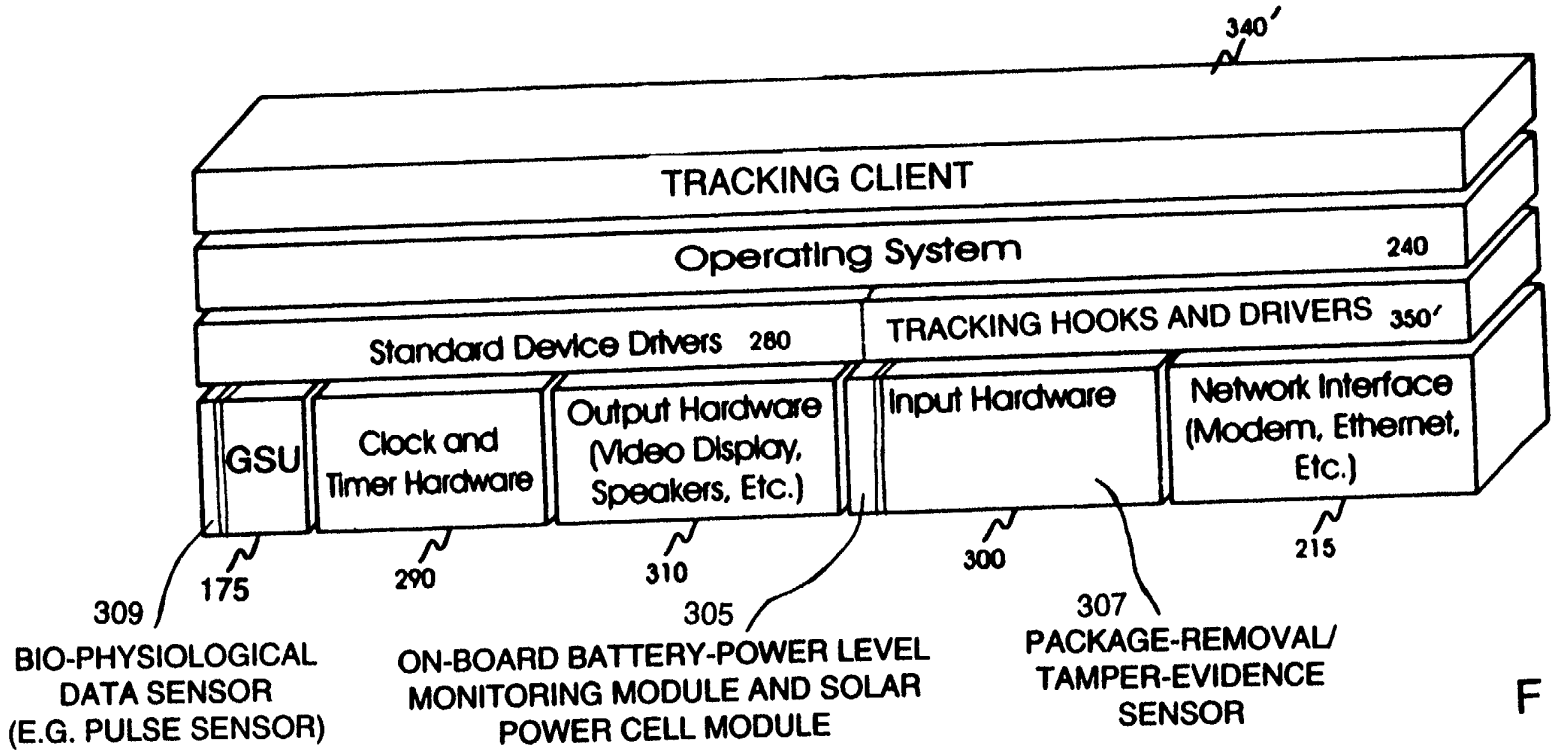


FIG. 19A

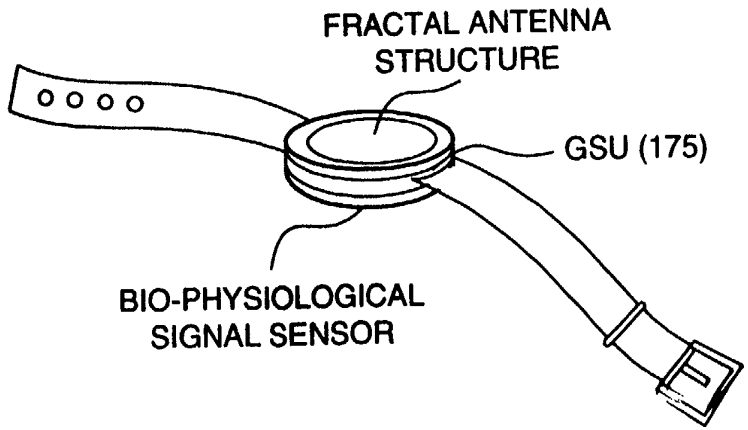


FIG. 19B

09820 "0654T650

TIME-SPACE BIOPHYSIOLOGICAL (TSB)
STAMPING BASED TRACKING SERVER 1007

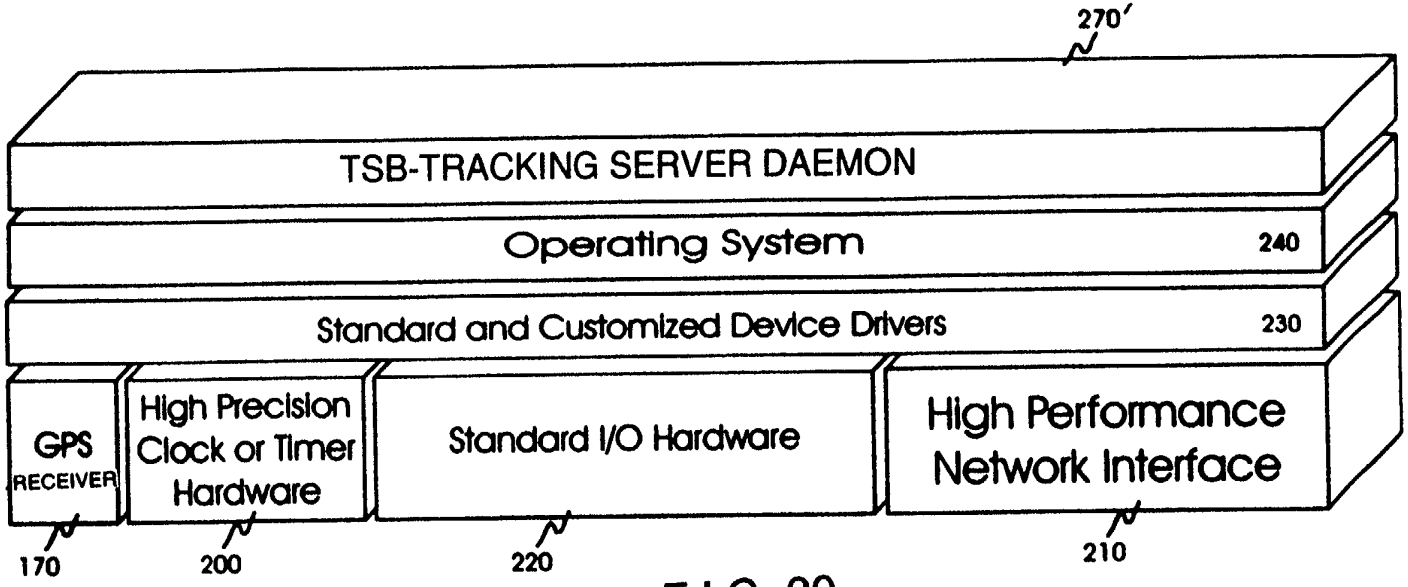


FIG. 20

(T,S,B) COORDINATE TRACKING OF MOBILE OBJECTS

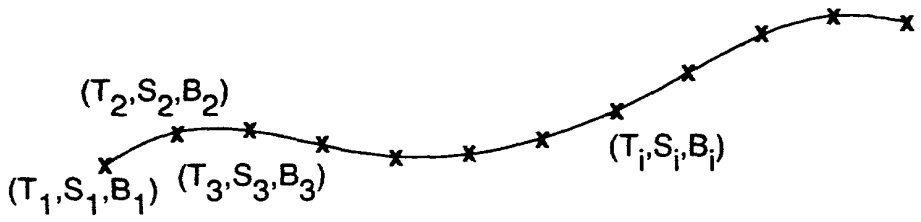


FIG. 21

OWNER/OBJECT DATABASE TABLE

OBJECT NAME	OBJECT OWNER	GSU'S UNIQUE ID CODE (UIC)	TSB STAMP		TSB STAMP
TOM SMITH	TOM SMITH	1567N2B0	(T_1,S_1,B_1)		(T_i,S_i,B_i)
JERRY DOG	TOM SMITH	1568N2B0	(T_1,S_1,B_1)		(T_i,S_i,B_i)
VOLVO S80	TOM SMITH	1569N2B0	(T_1,S_1,B_1)		(T_i,S_i,B_i)
o o o	o o o	o o o	o o o	ooo	o o o

FIG. 22

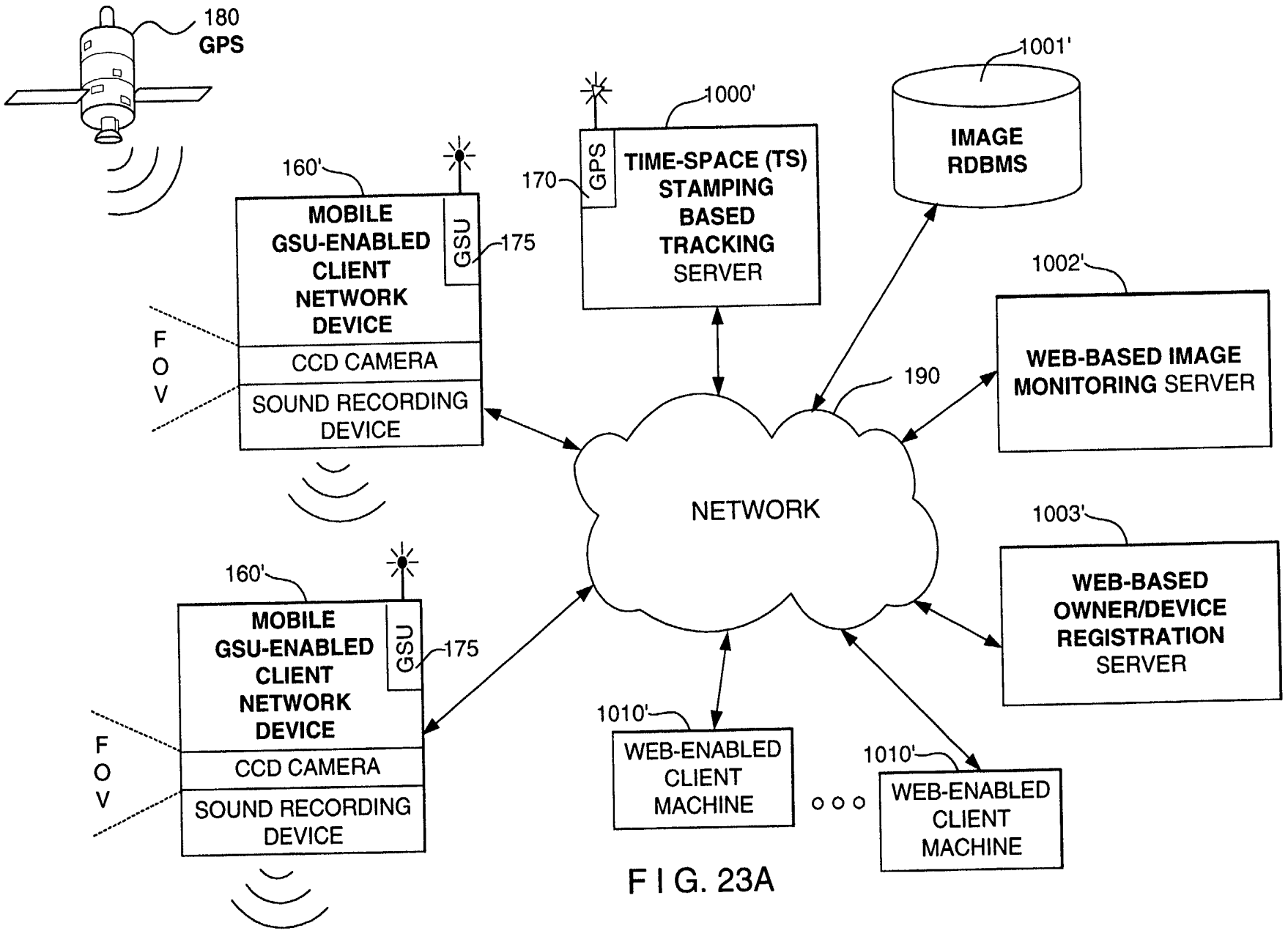

180
GPS
1001'
IMAGE
RDBMS
1000'
GPS
TIME-SPACE (TS)
STAMPING
BASED
TRACKING
SERVER
170
160'
MOBILE
GSU-ENABLED
CLIENT
NETWORK
DEVICE
GSU
175
CCD CAMERA
SOUND RECORDING
DEVICE
F
O
V
1002'
WEB-BASED IMAGE
MONITORING SERVER
190
NETWORK
1003'
WEB-BASED
OWNER/DEVICE
REGISTRATION
SERVER
160'
MOBILE
GSU-ENABLED
CLIENT
NETWORK
DEVICE
GSU
175
CCD CAMERA
SOUND RECORDING
DEVICE
F
O
V
1010'
WEB-ENABLED
CLIENT
MACHINE
o o o
1010'
WEB-ENABLED
CLIENT
MACHINE

FIG. 23A

GSU-ENABLED CLIENT NETWORK DEVICE	TS-STAMPED CAPTURED IMAGE			
	T1	T2	ooo	TN
X125132			ooo	
X123561			ooo	
⋮				
X351275			ooo	

FIG. 23B

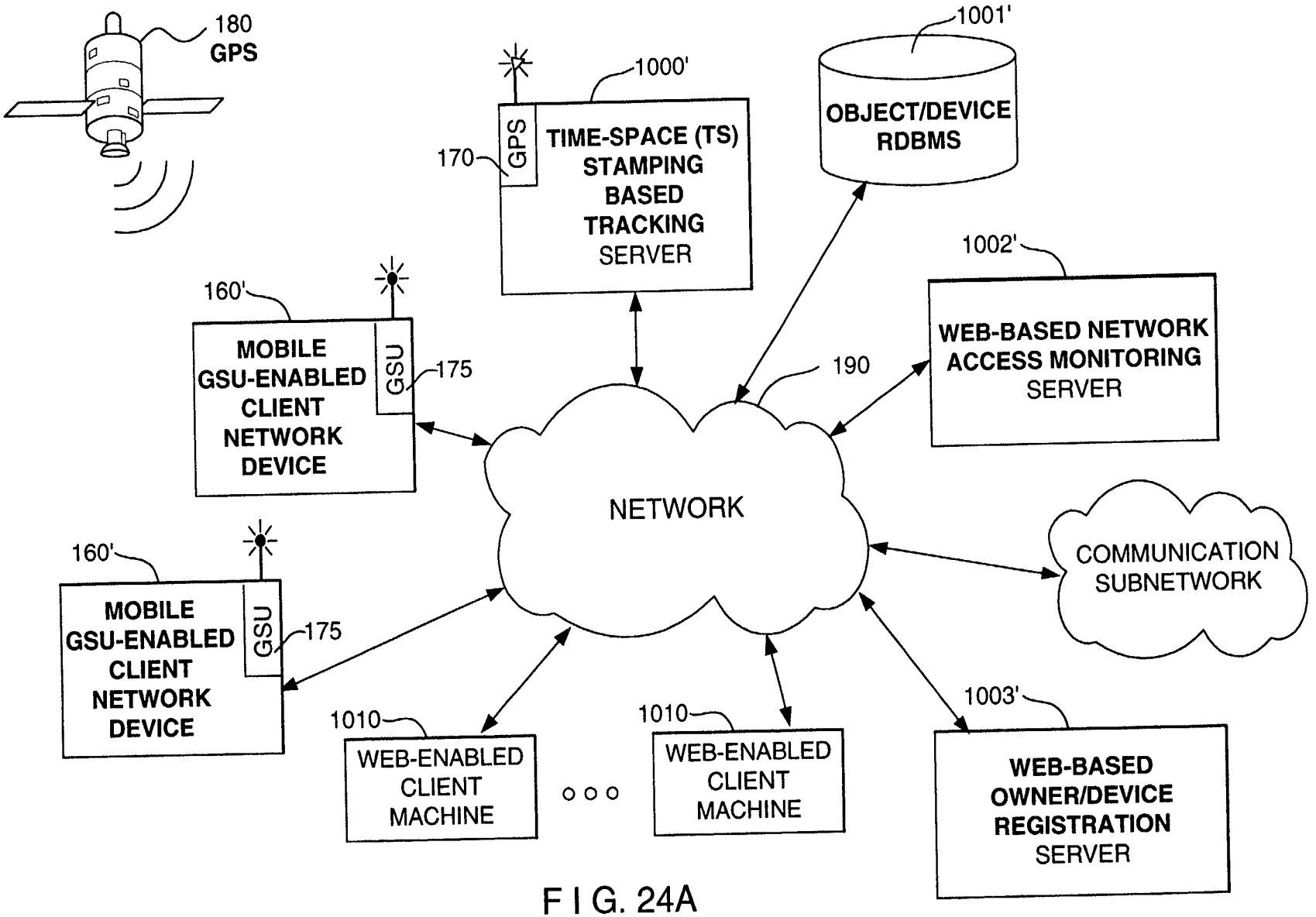

180
GPS
1000'
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001'
OBJECT/DEVICE RDBMS
1002'
WEB-BASED NETWORK ACCESS MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
190
NETWORK
COMMUNICATION SUBNETWORK
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
1010
WEB-ENABLED CLIENT MACHINE
o o o
1010
WEB-ENABLED CLIENT MACHINE
1003'
WEB-BASED OWNER/DEVICE REGISTRATION SERVER

FIG. 24A

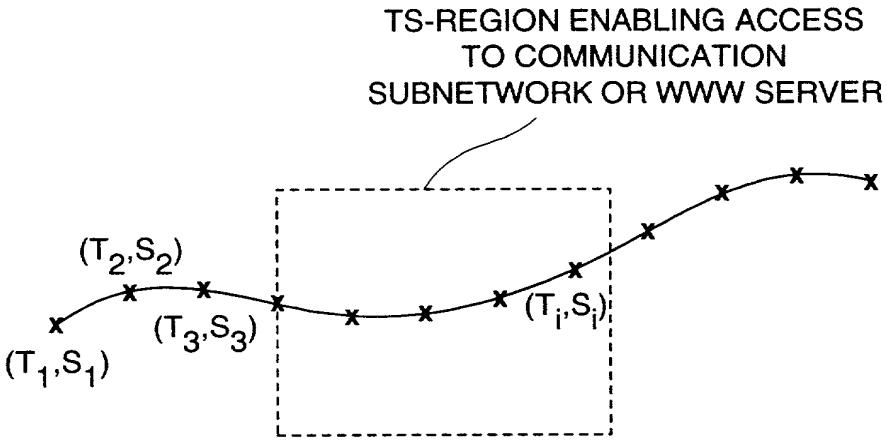


FIG. 24B

EXHIBIT 1008 - 91/101

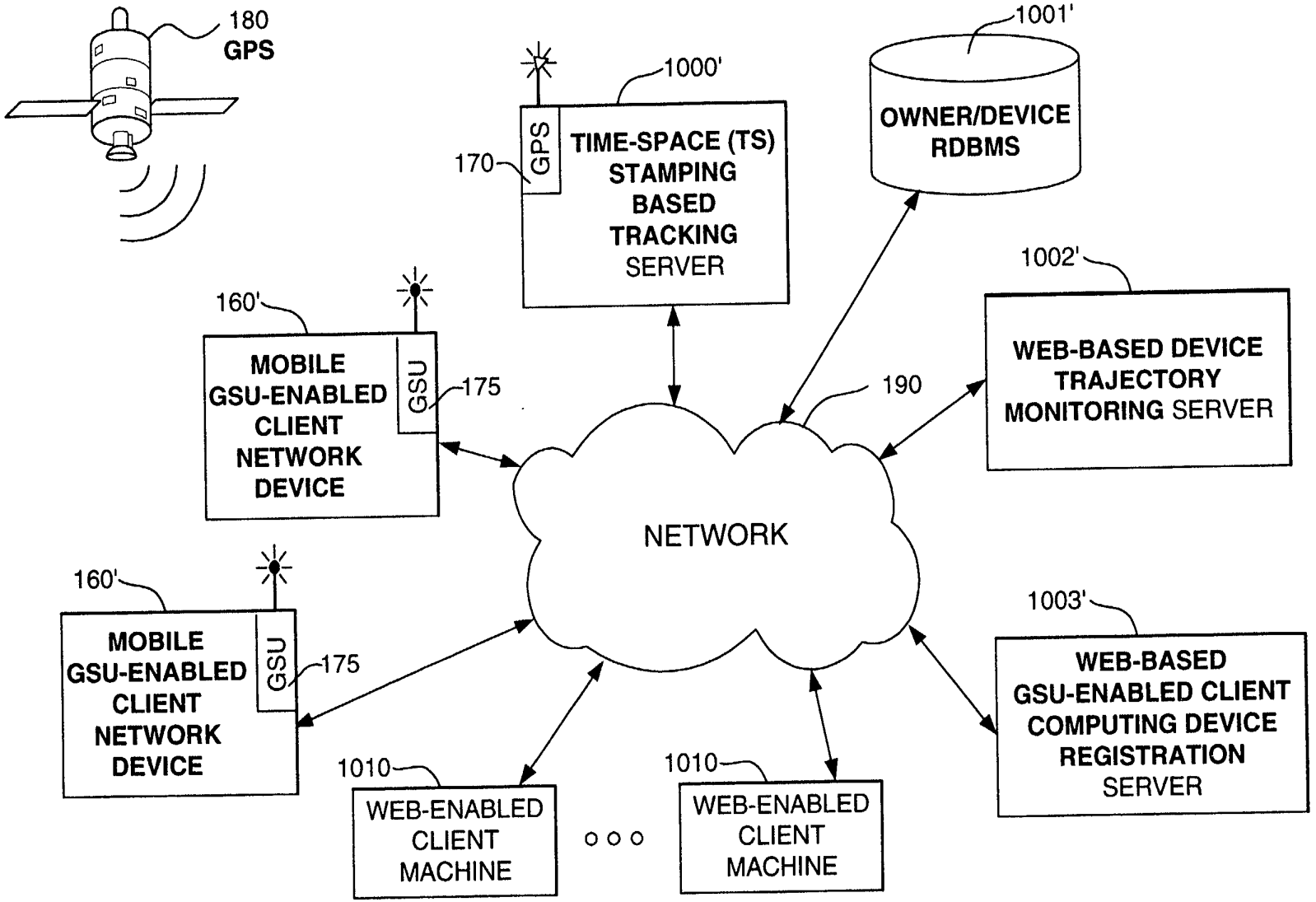

180
GPS
1000'
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001'
OWNER/DEVICE RDBMS
1002'
WEB-BASED DEVICE TRAJECTORY MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
190
NETWORK
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
1003'
WEB-BASED GSU-ENABLED CLIENT COMPUTING DEVICE REGISTRATION SERVER
1010
WEB-ENABLED CLIENT MACHINE
o o o
1010
WEB-ENABLED CLIENT MACHINE

FIG. 25A

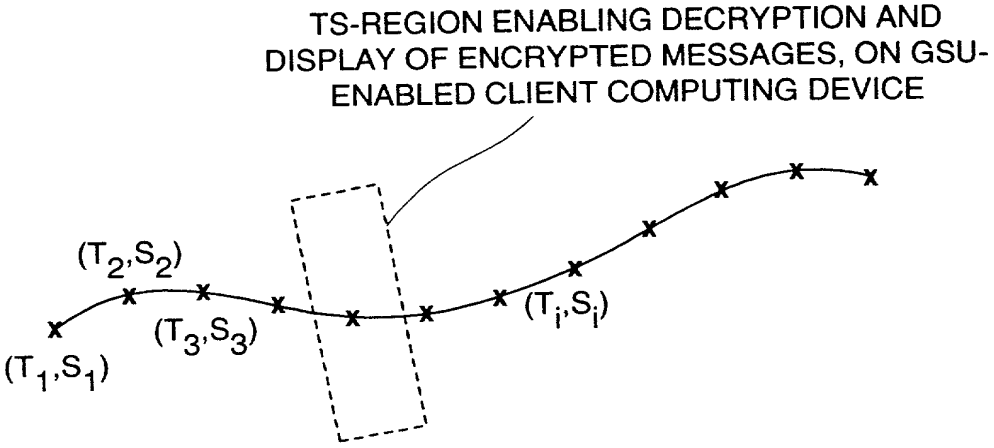

TS-REGION ENABLING DECRYPTION AND DISPLAY OF ENCRYPTED MESSAGES, ON GSU-ENABLED CLIENT COMPUTING DEVICE
(T_2,S_2)
(T_3,S_3)
(T_1,S_1)
(T_i,S_i)

FIG. 25B

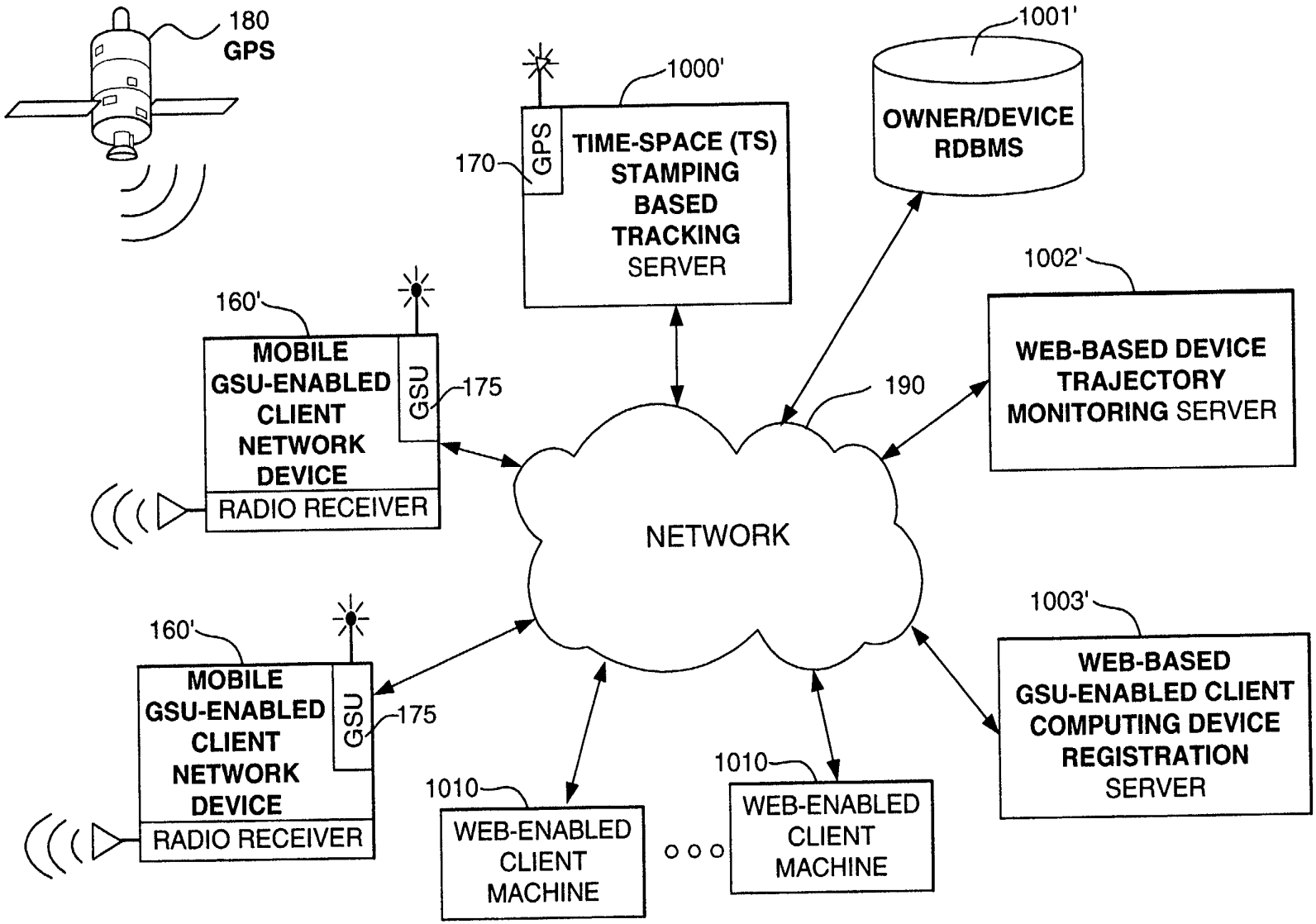

180
GPS
1000'
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001'
OWNER/DEVICE RDBMS
1002'
WEB-BASED DEVICE TRAJECTORY MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
RADIO RECEIVER
190
NETWORK
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
RADIO RECEIVER
1003'
WEB-BASED GSU-ENABLED CLIENT COMPUTING DEVICE REGISTRATION SERVER
1010
WEB-ENABLED CLIENT MACHINE
1010
WEB-ENABLED CLIENT MACHINE

FIG. 26A

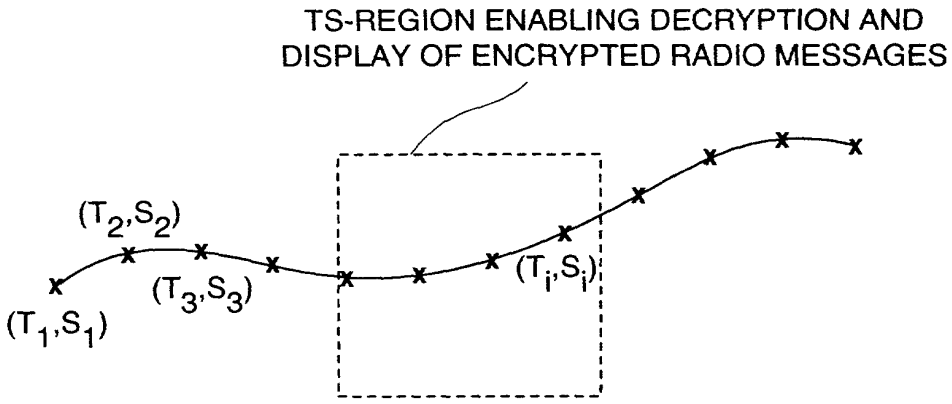


FIG. 26B

05505505 : 050505

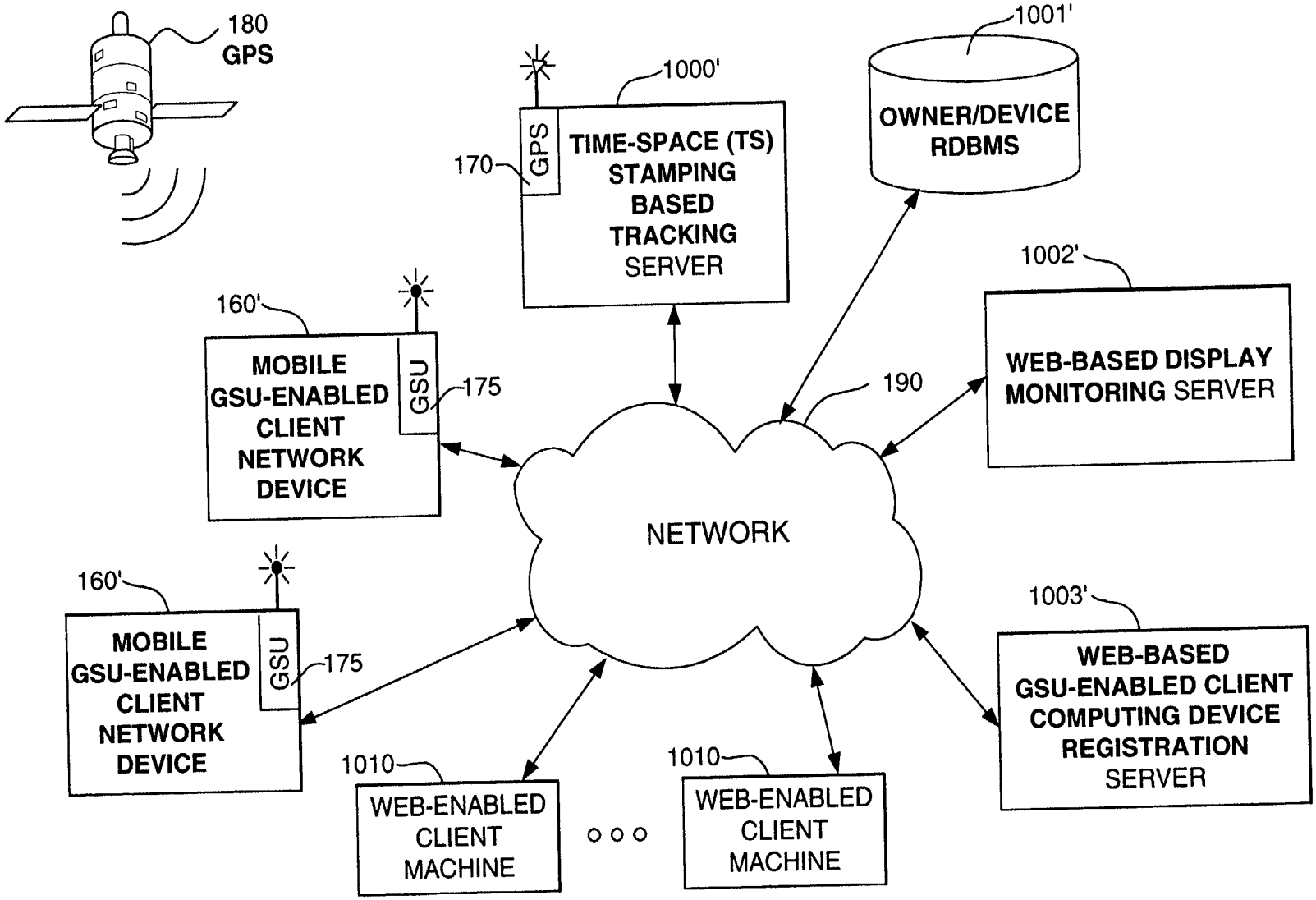

180
GPS
1000'
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001'
OWNER/DEVICE RDBMS
1002'
WEB-BASED DISPLAY MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
190
NETWORK
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
1003'
WEB-BASED GSU-ENABLED CLIENT COMPUTING DEVICE REGISTRATION SERVER
1010
WEB-ENABLED CLIENT MACHINE
o o o
1010
WEB-ENABLED CLIENT MACHINE

FIG. 27A

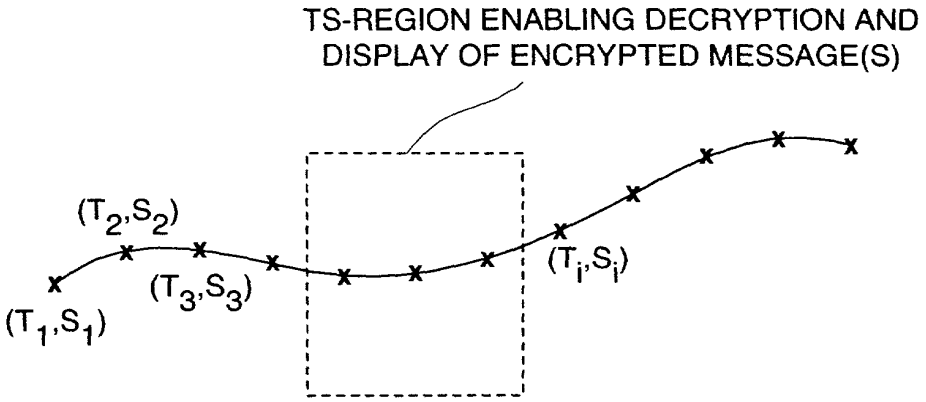


FIG. 27B

09/754,938 - 01/05/2001

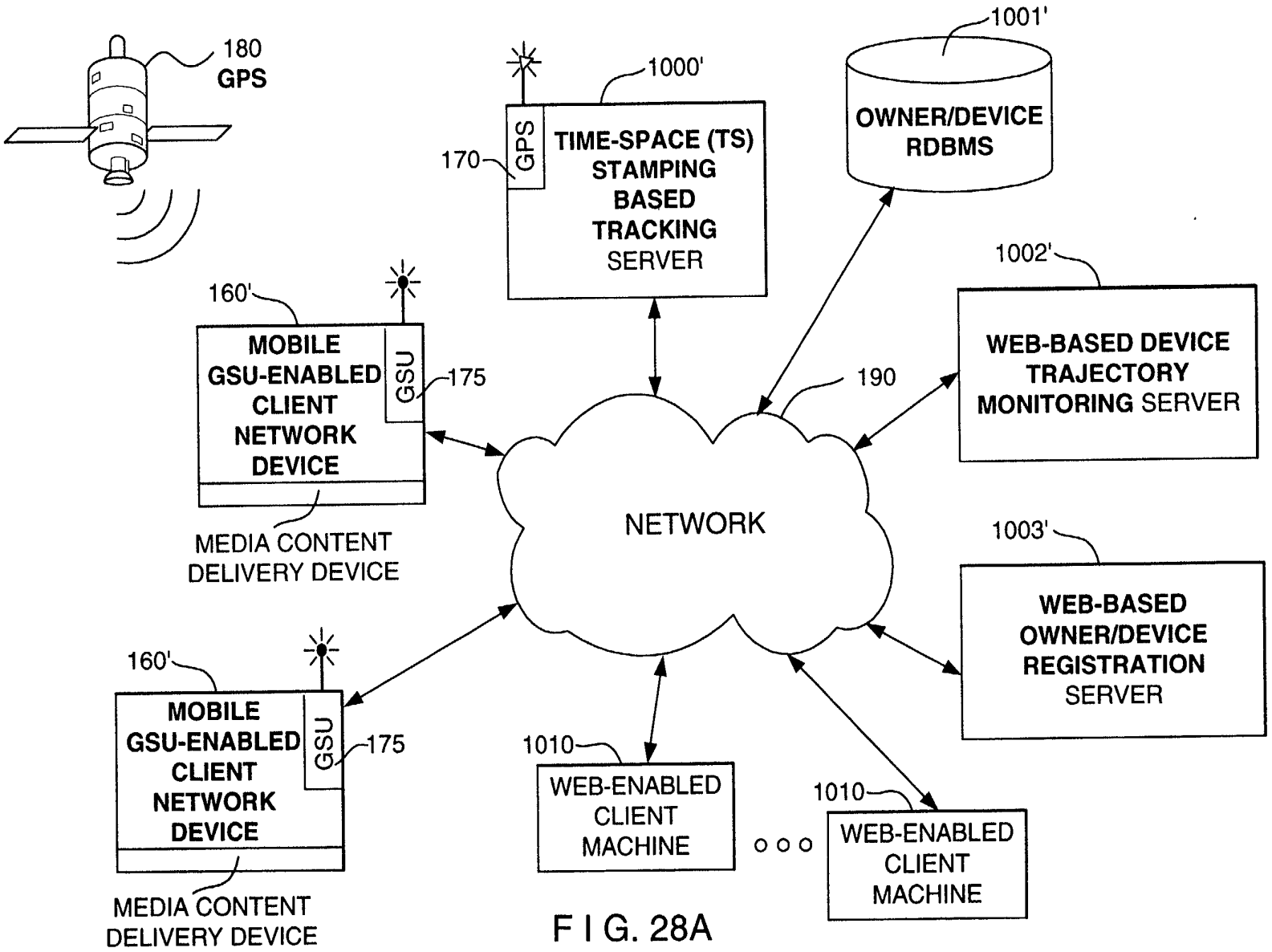

180
GPS
1000'
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001'
OWNER/DEVICE RDBMS
1002'
WEB-BASED DEVICE TRAJECTORY MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
MEDIA CONTENT DELIVERY DEVICE
190
NETWORK
1003'
WEB-BASED OWNER/DEVICE REGISTRATION SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
MEDIA CONTENT DELIVERY DEVICE
1010
WEB-ENABLED CLIENT MACHINE
o o o
1010
WEB-ENABLED CLIENT MACHINE

FIG. 28A

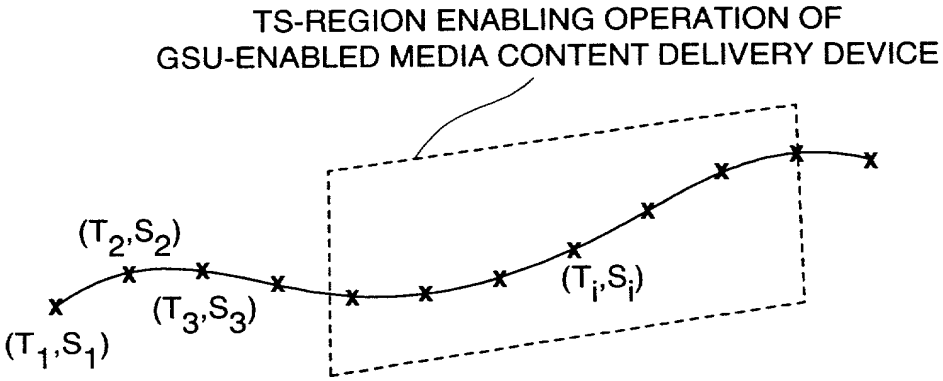

TS-REGION ENABLING OPERATION OF
GSU-ENABLED MEDIA CONTENT DELIVERY DEVICE
(T_2,S_2)
(T_3,S_3)
(T_1,S_1)
(T_i,S_i)

FIG. 28B

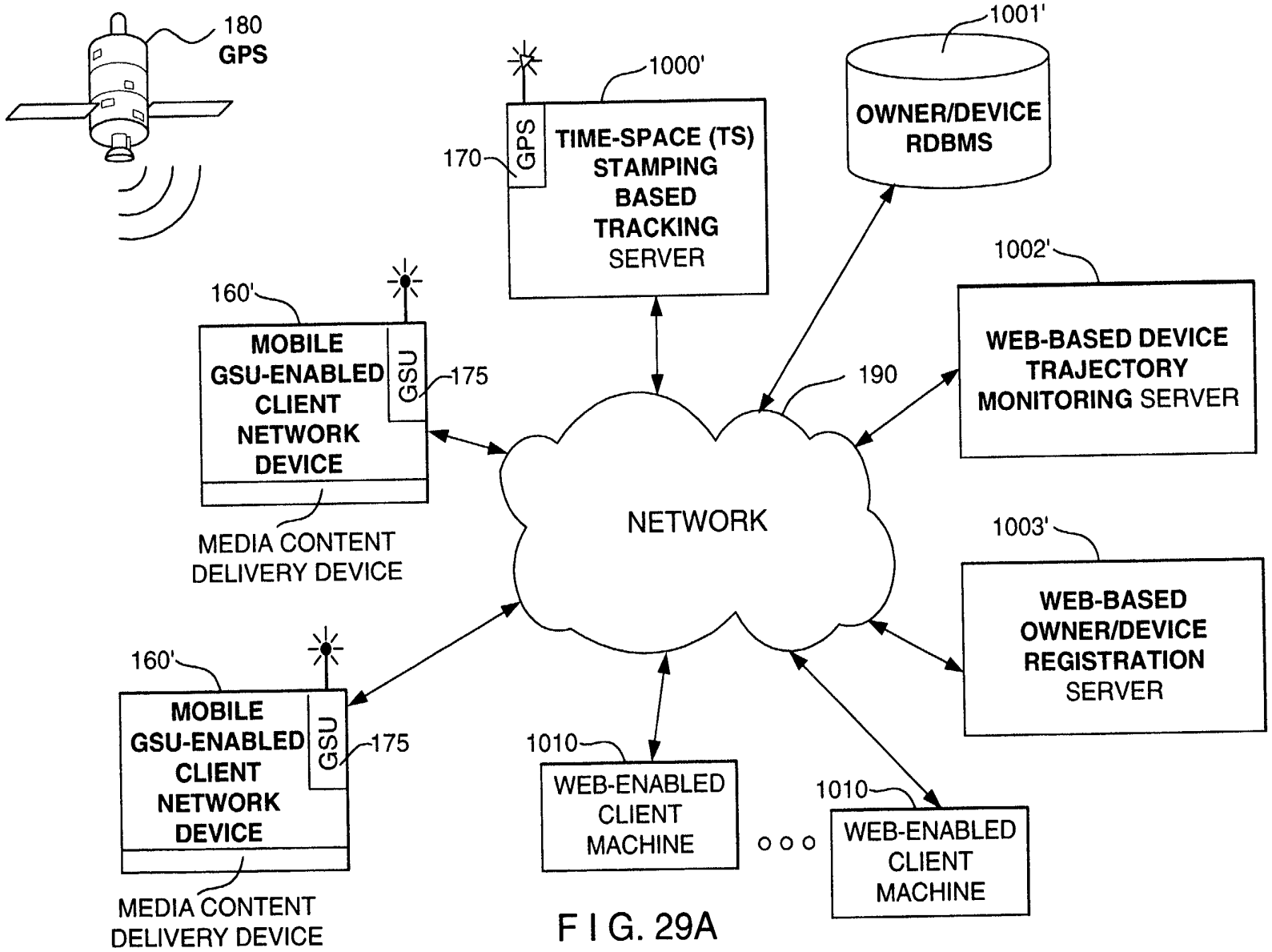

180
GPS
1000'
GPS
170
TIME-SPACE (TS) STAMPING BASED TRACKING SERVER
1001'
OWNER/DEVICE RDBMS
1002'
WEB-BASED DEVICE TRAJECTORY MONITORING SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
MEDIA CONTENT DELIVERY DEVICE
190
NETWORK
1003'
WEB-BASED OWNER/DEVICE REGISTRATION SERVER
160'
MOBILE GSU-ENABLED CLIENT NETWORK DEVICE
GSU
175
MEDIA CONTENT DELIVERY DEVICE
1010
WEB-ENABLED CLIENT MACHINE
o o o
1010
WEB-ENABLED CLIENT MACHINE

FIG. 29A

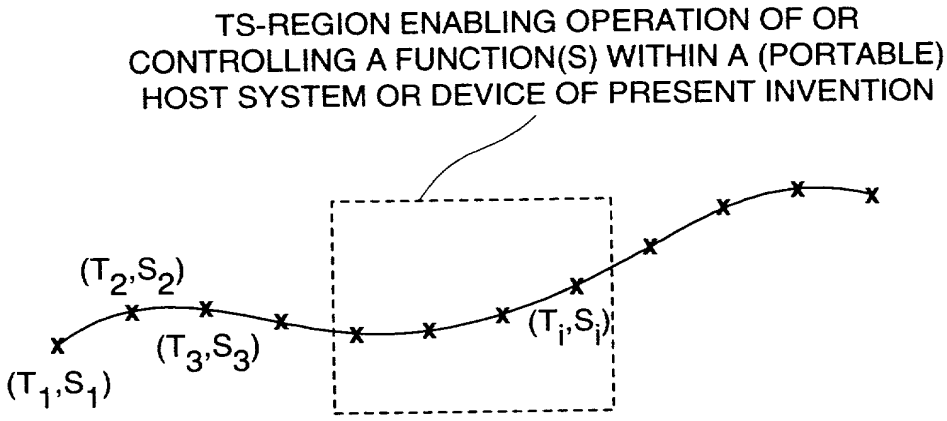

TS-REGION ENABLING OPERATION OF OR
CONTROLLING A FUNCTION(S) WITHIN A (PORTABLE)
HOST SYSTEM OR DEVICE OF PRESENT INVENTION
(T_2,S_2)
(T_3,S_3)
(T_1,S_1)
(T_i,S_i)

FIG. 29B